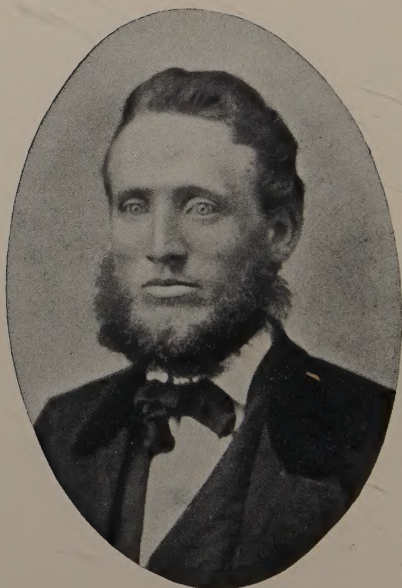


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Ethel A. Sicron.
U. H. S.



The Author in 1861.

"That very law which moulds a tear,
And bids it trickle from its source,—
That law preserves the earth a sphere,
And guides the planets in their course."

Theory of the Universe

THE UNIVERSAL LAWS IN NATURE
APPLIED TO THE ATOMS
OF MATTER.

Light, Heat, Electricity and Magnetism
Clearly Explained.

*Explicitly Tracing the Phenomena of Nature, the Light and
Heat of the Sun to the Universal Laws Operating
Over the Atoms of Matter.*

BY M. P. SWEET.

Also a Poem by the Author.

A. D. 1908.

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Theory of the Universe

ERRATUM.

The word "not" in line 16 on Page 10 should be excluded.

THEORY OF THE UNIVERSE.

INTRODUCTION.

JANUARY 10th, 1907.



HIS volume was written in 1861. At that time the World was not ready to consider the propositions therein contained. But since then the wonderful discoveries and advancement in science has clearly established the fact that the conclusions therein arrived at are universal laws, established by the Creator in all his works.

The following are some of the great inventions and discoveries made since this volume was written, and are evidences of the theory and propositions set forth in this work, viz:

CLIPPINGS FROM PERIODICALS

“The telephone that takes your speech, keeps it unuttered if your friend happens to be out, but speaks it into his ear as soon as he returns, whether the interval be an hour or a week—must be regarded as a marvel of marvels. That machine may consist either of a steel wire wound on a revolving drum, or of a hard steel disk revolving in a horizontal plane. Above the revolving wire, or disk, is placed a small electro-magnet actuated by the telephone circuit. All the varying impulses that come over the telephone wire under the influence of the speaker’s voice

are imparted by the little magnet to the steel moving beneath it, and they make upon that steel surface a series of magnetic impressions, like invisible dots, each of which possesses its own peculiar polarity and degree of intensity. It is just as if the steel were a sheet of paper and the magnet a pen, and the magnetic impulses a series of alphabetical signs jotted down on the paper—only nothing is visible to the eye. But the hundreds of little magnetic poles are there, though unseen, and when the wire or plate carrying these mystic hieroglyphics is again passed under the electro-magnet (the latter being now connected with a telephone receiver), they reproduce exactly the same impulses that created them, and these impulses passing into the receiver vibrate the speaking membrane and give forth the voice and the words which they had stored up.

The only thing that a man who has a telegraphone in his office needs to do is to set the apparatus going when he has time to listen to it, and if any of his friends have been speaking to it while he was out, or busy, or asleep, their messages will be repeated."

"In the realm of electricity recent investigations have confirmed the suspected connection between electricity, magnetism, light and radiant heat. They have also given a new impulse to speculations as to the structure of matter altogether and the modes of transmission of energy. Prof. Hertz, an eminent German investigator, by an ingenious contrivance termed a reflecting board, discovered that electrical waves are transmitted through the air exactly as luminous or sound vibrations are, and that electricity is propagated like heat and light at some measurable speed."

"The phenomena of electrical discharges in vacuum tubes give the nearest approach to seeing electricity that are likely to be made. The streams of corpuscles propelled along the tubes suggested to Crookes in 1870 the idea of

a fourth state of matters, and these corpuscles—smaller than atoms, and the same in all kinds of gases—were named electrons by Stoney, and have come to be regarded as the electrical parts of all atoms, or even as making up matter itself.”

“Nikola Tesla, who, from time to time, has been surprising the scientific world by new discoveries of the possibilities of electricity, has in his latest machine, he believes, achieved his greatest success.

He demonstrates the scientific possibility of creating brilliant illumination by means of vacuum tubes, which are not in mechanical contact with the electric source.”

“The instrument known as an actinometer formerly employed only chemical means for detecting the intensity of the sun’s rays, and only chemical or actinic effects were thus measured. But a long series of experiments in this particular field has led Messrs Rigollot and Marechal to invent an actinometer in which a perceptible electric current is set flowing by solar action through a copper strip from the end of the instrument, which is exposed to strong sunlight toward the other, which is shielded from light. This instrument has been developed sufficiently to transmit signals over a wire for more than six miles. When luminous rays were focussed on the sensitive plate of the apparatus at one point, a galvanometer in the circuit at another point was instantly deflected; and as soon as the light was turned off the needle returned to its normal position.”

“Investigations show that the length of spark varies directly as the electro-motive force, that is to say, the length of the spark is measured by the strength behind it.”

“Mother Earth is herself the greatest manufacturer of high explosives. When a volcano breaks out afresh, the accompanying earthquake shocks and convulsions open great seams beneath the sea for renewed inception of

water, which is quickly converted into steam or dissociated gases, which rush to vent themselves at the volcano, carrying along with them great quantities of lava and broken rock, to be belched forth sometimes to enormous heights. The force with which scoria and fragments of rock are propelled up the shaft of a volcanic crater is comparable with that which would be exerted by a continuous explosion of dynamite. When an oil-well is torpedoed, we have, while it lasts, a volcano in minature."

"Deep wells have been sunk in various parts of the world, and observations taken in these go to show that the interior of the earth is of a uniform temperature. The second deepest hole in the world is the Schaladaback salt well, near Leipsic, which is 5,740 feet deep. At the bottom of this well the temperature is 135.5 degrees. At the bottom of the Sperenburg salt well, near Berlin, 4,170 feet deep, the temperature is 110 degrees. At the bottom of a well recently sunk near Wheeling, W. Va., to a depth of 4,500 feet, the temperature is also 110 degrees. Thus it will be seen that the temperature at a given depth in various localities is almost uniform."

"Alexander Young, the well-known astronomer, of LaPorte, Ind., several years ago stated his conclusions as to the condition of the great orb of day and the errors astronomers have fallen into through mistaking its electrical reflection for the planet itself. His theory that the sun is not a superheated terrestrial body at all, but a planet favored with a mild climate, a beautifully variegated surface and a benign atmosphere, capable of sustaining high forms of life. He said: 'The sun is one of the Lord's grand central dynamo stations for the universe: other planets are the sub-stations, deriving their electrical energy from the solar source of supply. Electricity is the life principle of all nature, and it streams from the sun through the infinite inter-stellar and inter-planetary spaces, and from planet to

plane: and back again to the sun in constantly active currents. All heat and all light proceed from these electric streams, for as they pass from atmosphere to atmosphere and through spaces void or almost void, of even the most ethereal gas they meet with resistance of varying intensity and in overcoming that resistance give off heat and light. The atmosphere surrounding the sun reflects the light of the electrical currents passing out from it, and we see that reflection through our own atmosphere, similarly lighted and call it the sun. The same currents passing through our atmosphere engender heat, and we call it the sun's heat.'"

"According to Prof. Young no heat, no light, ever passed from sun to earth, except as we may conceive it as being stored up in an electric ray, to be given out by the method of transformation described, by overcoming resistance. No human eye, even with the most powerful aid to vision, has ever pierced the sun's atmosphere and viewed that glorious orb, save that of Alexander Young, projected by his solarscope. None but he has ever viewed the spots on the sun. The sunspots that astronomers see with their telescopes are tricks played upon the vision by the weird effects of electrical reflections on atmospheric phenomena occurring in or just beyond the outermost regions of the earth's protecting shield of gaseous fluid.

"In other words the spots on the sun are really accumulations of nebulous clouds just off the earth."

CHAPTER I.

Two Universal Forces in Nature.



AS we look back through the vista of ages we see how slow the scientific growth progressed in the early ages and almost down to the present age of remarkable progress, along that line. It makes no difference how true a theory may be, unless it is established and proven by absolute facts, brought out by sight-seeing, investigations, or founded on some reasonable conclusion having reference to something that has hereto been accepted as true, by which comparison we may consistently solve the problem, the world will be slow to accept it. Down to 500 years before the time of Christ, no true science of the universe was taught or known by the ancients, and even the true solar system, taught by the eminent Greek philosopher, Pythagoras, at that time, was soon after disregarded, and various false systems taught in its place, until between 300 and 400 years ago, when Copernicus revived the true system which had been discovered by the great Pythagoras.

Previous to the discovery of America by Columbus, the people generally considered the earth to be of a flat surface, and navigators durst not venture far from land for fear of being tumbled off into the supposed pit below. And thus ignorance made cowards of them all, as it were, and Columbus was considered of unsound mind by the great majority of the world at large, having few promoters in his desired undertaking to open up a new world; but his great

discovery clearly illustrated the fact of the rotundity of the earth, and the establishment of the law of gravitation, which was afterward discovered to be the same force that held the planets in their course or orbit around the sun.

Ignorance and superstition of former ages has had a tendency to hold back the progress of science in the past. Superstition has disposed the many minds to attribute all the changes and movements in the natural world to the personal and direct hand of Deity, instead of applying the more reasonable and enlarged and more comprehensive way as science finds it; that materiality is governed by fixed and established laws and forces applied to it in the beginning and creation of the world. That is, God made the world to run from the beginning without his personal supervision; or the least supervision possible. That every atom of matter has certain forces imparted to it, which never have been known to change, and not a single atom of matter is ever lost in all the molecular changes that are constantly going on in the universe—not one atom lost or destroyed, nor a single law changed or abated since the world begun; and this will continue on forever I firmly believe.

These truths have been fully established during the last forty-five years, which have accomplished more scientifically than all the previous centuries. Old superstitious ideas and theories have been exploded and abandoned, and the true inwardness of nature is rapidly being seen and discovered.

In the realm of electricity, recent investigations have confirmed the suspected connection between electricity, magnetism, light and radiant heat. They have also given a new impulse to speculation as to the structure of matter altogether and modes of transmission of energy. The unsolved mysteries of the universe, such as the heat and light of the sun, as well as all the phenomena in nature must be

worked out through the laws and forces that we find operating in the minute atoms of matter around us.

“That very law which moulds a tear,
And bids it trickle from its source;
That law preserves the earth a sphere,
And guides the planets in their course.”

That the law of attraction and repulsion, operating over the atoms of matter in the universe produces materiality as we find it, and in this line the solution of the phenomena of the universe must be worked out, especially in the inorganic world.

We should look upon materiality as consisting of atoms which act automatically in their operations in nature. So made and constructed from the foundation of the world by the hand of Deity, so that the world may run without His personal supervision; that as He has power to create, must necessarily have power to produce materiality with inherent forces to cause it to operate automatically as we find it. Therefore, we say that the atoms of matter have forces imparted to them from the creation of the world, and that none of these atoms are ever lost, destroyed or impaired, or the forces imparted thereto lost or diminished. That these atoms are distributed through space, first uniting to form molecules and these molecules uniting to form the solids, liquids and gases which constitute the formation of the earth and all the heavenly bodies. That the materiality of all worlds are alike or nearly so. That in the beginning all substances were in a gaseous state, and as matter cooled down and concentrated into large bodies like the earth, these gases were converted into a liquid molten mass, and finally into solids, liquids and gases as we now find them. The excess positive material constituting the ether of the earth, which in motion produces light, heat and electricity, etc., and the remainder constitutes the go-between which holds the negative materiality together and

makes up the nucleus of the earth and the atmosphere which surrounds it. And the surplus ether, that portion not required to hold the negative materiality in combination, rises above the atmosphere proper which surrounds the earth to the height of some thirty-five miles, and produces and makes up an ethereal atmosphere of positive materiality, which extends many miles above the air or gaseous atmosphere which surrounds the surface of the earth; and according to the assumption of the universality of matter, that all the heavenly bodies are made up approximately of the same material, they will have ethereal atmospheres similar to that of the earth, our sun not excepted, in proportion to their negative materiality. That by the repulsive forces of these ethereal atmospheres, as that of the sun over that of the earth, produces the solar light and heat and many electrical phenomena not experienced here on the earth, as, for instance, the Northern Lights, the Aurora Borealis, the magnetism of the earth, etc.

We may readily comprehend the effect of an ethereal atmosphere of that of the sun, which probably extends many thousands of miles beyond that of its gaseous atmosphere, over that of the earth's ethereal atmosphere. As the atoms of each atmosphere are repulsive to each other, these atmospheres must necessarily exert a wonderful repulsive force over each other, driving the ocean of ether further away, just the opposite of an attractive force which would produce an elevated tidal wave. The repulsive force would be downward towards the earth's surface and outward towards the poles of the earth, producing the Northern Lights, etc. Were it not for the revolution of the heavenly bodies on their axes, this repulsive force would become inoperative so far as producing light and heat is concerned, as these forces would drive the ether of the earth towards the side most remote from the sun, producing an ethereal tide on that side and would remain at rest, but by the constant motion of the earth on its axis this ocean of ether is

being continually brought under the influence of the sun's ether, and a constant flow of the earth's ether is being constantly repelled down towards the surface of the earth from the earth's ethereal atmosphere, producing the sun's light and heat, etc. That consequently the sun's light and heat is produced by the motion given to the ether of the earth by the repulsive influence of the sun's ether over that of the earth's; that it is ether in motion that produces light and heat and also electricity and magnetism.

The above shows why it is warmer in the upper atmosphere at the poles than at the equator of the earth.

"Prof. Hergesell, of Strasburg University, stated that the atmosphere at high altitudes is the coolest over the equator and the warmest over the poles. This has been ascertained, he said, under the auspices of the international committee which has been investigating the atmosphere at high altitudes by observations taken with automatic instruments attached to unmanned balloons.

"Balloons which reached altitudes of eleven to twelve and one-half miles in the tropics were found to have registered about 148 degrees below zero Fahrenheit, while in the latitude of Central Europe the temperature was only 76 to 85 below zero at the heights indicated.

"Another fact established by these balloon ascents is that the greatest cold of the upper atmosphere is reached at heights of from six to six and three-quarter miles. Above that height, contrary to the assumption of scientists hitherto, the air actually grows warmer.

"Prof. Hergesell concludes that the atmospheric conditions affecting the weather do not reach higher than seven miles."

We live in a world of wonders and mysteries, many of which we cannot comprehend. Yet there are problems in nature's wonders which can be worked out and comprehended by the investigating and inquiring mind of man. While this is so, there are roads and paths that better not

be traveled with a purpose to solve the mysteries that surround them on every hand; mysteries that none can comprehend or explain, the causes of which are among the incomprehensible. You might ask me what causes one body to attract another body, or one body to repel another body? I can only tell you the world will never know. However much the world may advance in science, no one will ever be able to tell you. Yet these forces we know do exist and are part of our existence here on earth, and the world could not exist without them. They are part of nature itself and are imparted to every atom of matter. You might ask me where the material came from that makes and forms the earth and the heavenly bodies above and around us? I can only tell you, the world will never know. I will have to prophesy that with all the advancement in science in ages past and yet to come, the world will never know. These are among the incomprehensible things in the universe, and are beyond even the X-rays of the mind of man.

In studying nature we are always looking to a cause for things to exist in the manner they do. This is well, for in a general sense there is a cause for the existence of all things. Yet the first cause is incomprehensible to us, and all we can say is that the first cause must necessarily be uncaused, which in itself is no explanation at all; yet we cannot ignore the fact—we know it is so. Some say nature is the first cause, and therefore doubting the existence of a Creator. This is foolhardiness; for leaving it with nature will not solve the mystery, and is just as incomprehensible to us and leaves us in doubt of the future existence of man, and tends to banish all hope of a future existence. For if nature is the first cause, at death we will return to it, which will end our existence here.

We believe there is a God; and in the beginning we believe with Moses: "That God created the heaven and the earth, and the earth was without form and void, and dark-

ness was upon the face of the deep." That is to say, in the beginning God imparted every force that exists in the atoms of matter; which causes the atoms to unite to form molecules, and those molecules to unite to make up the materiality of which the earth and all the heavenly bodies consist. We believe that when the earth was made there was imparted to materiality all the forces that we see existing in nature today. That is, God made the worlds to run from the beginning just as they run today, and for aught we know, will run on forever. That man is created in this world to live and exist subject to fixed, unchangeable laws, which he must live under and abide by, or suffer the consequences of their infringement or violation.

The greater share of the misery in this world is caused by disobedience of the natural laws, many times through ignorance of them. We should study them more in order to avoid the consequences of such disobedience. We must first know them in order that we may escape infringement of them. And in making new discoveries in science we should endeavor to work out scientific problems from the simplest standpoints. That is, we must assume that the Creator in forming the Universe did it in the easiest and simplest way possible; in such a way as to make it endurable and last forever. That is, materiality and the laws that are imparted thereto, will continue forever.

Sir Isaac Newton, in the fall of an apple, discovered the universal law of gravitation and on learning its workings we are led to say, Oh! how wonderful, yet how easy that is. The universal law of gravitation is simple enough, and it is a great wonder that it had not been discovered before Sir Isaac Newton's time. Yet it was not.

Yes, we believe that the world is made up of simplicities, yet we see complications. All nature is surrounded by mysteries, and these are materiality, attraction and repulsion existing in materiality. We take these forces, attraction and repulsion, connected with materiality and will en-

deavor to work out the problem, how the WORLD IS MADE from this materiality, connected with these forces—that is, the inorganic world. We say that is all simple enough; as easy as the solution of the universal law of gravitation, when applied to the inorganic world, which will be the sole subject of this volume.

In the inorganic world we have matter divided up into three distinct classes: 1st, Solids; 2nd, Liquids; 3rd, Gases; which make up the materiality of which the earth and the heavenly bodies are constructed and made, and these will be taken up in their order. These two forces, Attraction and Repulsion, connected with the atoms of matter, constitute the motive force which propel all the machinery in the artificial world; causes all the changes and convulsions in the natural world; builds up and destroys vegetation: in fact, they constitute the main spring in nature, without which no living thing could exist. These forces, operating in the minute atoms of matter, produce the molecular changes, which are the absolute cause of light, heat, electricity and magnetism.

Sir Isaac Newton's universal law of gravitation has solved the problem of the force and power that holds the planets in their courses round the sun. This law is universal. All heavenly bodies attract each other, at certain distances from each other; yet at certain distances they may repel each other, which I will endeavor to show before closing this volume. But we will first take up matter and consider how substances are formed.

SECTION I.

SUBSTANCES OR BODIES—HOW FORMED.

Matter is supposed to be composed of exceedingly minute spherical particles, which are held together by their mutual attraction, and are never themselves subdivided. These particles are called atoms and are generally consid-

ered to be of different sizes and weights. Their minuteness is shown by the fact that a single grain of musk will fill a room with its fragrance for years, without losing materially in weight, though the atoms given off during that time is beyond computation. And so we might say of aluminum, as regards the light it gives off.

Elementary substances are divided into solids, liquids and gases. We find in solids a cohesive attraction manifested over such atoms of matter, causing them to unite and consolidate; in liquids but little cohesive attraction; in the gases, none. On the contrary, there exists a repulsive force which tends to drive these molecules from each other. What causes matter naturally to assume these forms may be seen from the following considerations:

First—We will theoretically assume that all matter is composed of two classes; that there are more of one class than of the other. The greater, for convenience, we will term positive, and the lesser, negative.

Second—That atoms of different classes of matter, which we term *positive* or *negative*, attract each other; but of the same class, repel each other; that is, the positive atoms repel each other, and also the negative atoms repel each other; but the positive atoms attract the negative and vice versa.

Third—That the positive atoms are all of the same size and density, consequently each atom has the same attractive and repulsive force.

Fourth—That the negative atoms are of different sizes and densities, consequently they will have different attractive and repulsive forces.

Fifth—That *elementary substances* differ in the *size* or *density* of their negative atoms; therefore, each *elementary substance* will have the same size and density of negative atoms, but different elementary substances will have negatives of different *sizes* or *densities*.

Sixth—That the *attractive* is greater than the *repulsive* forces in the atoms of matter.

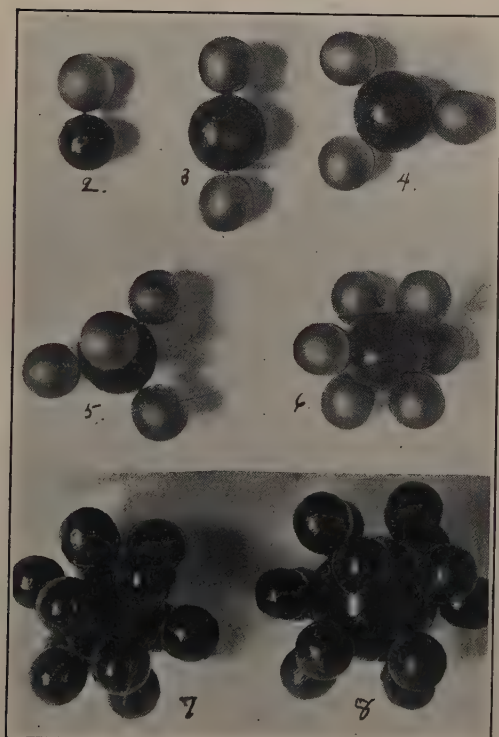
We have now before us six propositions, which we will assume to be true as we proceed in this work. And if we find them adequate to explain all the phenomena in the inorganic world, we must conclude that they are natural laws, written by the hand of Deity himself, in all his works.

To the solution thereof let us proceed in the following order: 1st, How are Solids formed? 2nd, Liquids? 3d, Gases?

According to Proposition 5, elementary substances differ in the size or density of their negative atoms. Consequently as the negatives of different substances are of different sizes, or densities, they will have different attractive and repulsive forces; larger the atoms, greater will be its forces, and vice versa, and hence will attract the positive atoms accordingly, depending on their size or density; that is, the larger or more dense the negative, greater will be their attraction for positive matter, and vice versa. Therefore some of the negatives will take one positive atom, others two, three, four, five and so on, as their attraction for the positive atoms may be, as shown in the opposite diagram.

In the illustration the dark colors represent the negative, and the light, the positive atoms. Each figure is intended to represent a molecule of an elementary substance. No. 2, a molecule containing one negative and one positive atom; No. 3, one negative and two positive atoms; No. 4, one negative to three positive atoms; No. 5, one negative to four positive atoms; No. 6, one negative to six positive atoms. And in no elementary substance is there any more than one negative atom in a molecule, although there may be many positive atoms in the same molecule. These molecules, in their combination with each other, constitute the solid, the liquid and the gaseous portions of our globe.

Solids are formed by the union of one negative with one



or two positive atoms. And in no case can the molecules of an elementary substance contain more than two positive atoms to one negative atom and exist in a natural solid state, as will be seen hereafter. Let the reader bear in mind that in all cases the negative atoms will be represented in dark colors, and the positive in light colors in this work. Also that the union of a negative with the positive atoms are called molecules, when they unite according to their natural affinity, as above represented, and the combination of the molecules with each other form solids, liquids and gases. And on the assumption that the attractive forces are stronger than the repulsive forces in the atoms of matter, and that the positive, which is the ether of the universe, is in excess of the negative materiality, we can readily comprehend the following facts, viz:

That as there is an excess of positive material over the negative in the universe, the negative atoms would take of the positive atoms to that extent as to produce molecules in a superficial positive condition, previous to their combination to form solids and liquids; and supposing the molecules to have been distributed throughout space, in their combination and magnetical union all the heavenly bodies would have originally been formed into a molten state. That in the primitive stage of the formation of the earth and heavenly bodies, as they were in a quasi-molten state, it took many years to bring materiality to the state we now find it. This will be considered under the head of Heat.

We will now consider nature as we now find it, in relation to our earth, etc., after this cooling process has gone on for ages, which was nothing more or less than the bringing of the atoms of matter together in accordance to their attractive and repulsive forces existing in the atoms of matter. Solids are formed in their natural state principally from molecules No. 2 and 3, yet some are produced by

the union of different molecules of gases. We can imagine how many and how different substances could be formed and produced from these different molecules, consisting of different forces and properties. Thus the union of molecules of No. 2 would produce one kind of materiality, and that of No. 3 another kind, and so on through the different kinds of molecules that exist in nature. Elementary liquids will be produced from molecules consisting of one negative atom to three or four positive atoms, or such a number of positive atoms that will not produce a gas. Hence liquids differ from gases in the amount of positive material. (See Gases considered.)

Gaseous molecules are repulsive to each other, from the fact that the negative atoms have so strong attraction or affinity for the positive atoms, that they take so many as to become completely surrounded by the positive atoms, making such molecules positively repulsive to each other, because they are superficially in the same positive condition, and on approximation will be repulsive to each other; like repelling like. All natural gases, therefore, may be said to contain molecules, the negatives of which are of such a size, or materiality, causing them to possess such an affinity for positive matter, that they will take such a number of positive atoms as to throw the molecules into a superficial positive repulsive condition. Such molecules will consequently repel each other, but will be attracted by the earth, and therefore subject to the laws of gravitation.

Elementary liquid molecules stand in the mean of those of solids and gases. Hence their molecules have a slight attraction for each other, just sufficient to give them the tendency to cohere. Their negatives not being sufficiently enveloped with positive matter to cause their molecules to be in an absolute positive condition, but approximating to it, depending in degree upon the amount of such positive matter thus surrounding the negative atoms, and

will not at all times, therefore, be alike, being controlled to a certain extent by the temperature of the body, which will be considered under the head of Liquifaction by Heat. In the above discourse we have only considered solids, liquids and gases in their natural state and elementary condition. Compound substances, liquids and gases produced artificially by heat, will be treated of in another place, in connection with natural compound bodies.

SECTION II.

ELEMENTARY SUBSTANCES CONSIDERED.

Elementary substances are those that have been supposed to contain but one kind of matter, or those which have never been separated into any other kind of matter. Although substances termed simple are in fact compound, composed of positive and negative atoms, and the positive and negative atoms constitute the two primitives in nature, and consequently all substances are composed of these two primitives, yet it is a fact now to be considered, that every elementary substance—so called—contains different molecules, and the difference in their molecules characterizes the different elementary substances. Therefore, the term elementary will be retained in this treatise as applying to the molecules in nature, instead of the two primitives. As there are as many different molecules as there are elementary substances, hence each kind of molecule represents an elementary substance.

Let it be borne in mind here that it is in the make up of the negatives in each elementary substance, in their molecule, that characterizes every elementary body in nature; that the positive atoms produce the combination of the negatives which make up the solid bodies, and in such combination as above set forth, produce the liquid and gaseous

formation in the form we see them. Whether the negative atoms have any other forces than the attractive and repulsive imparted to them, will not be considered here. Yet we believe that these two forces, the attractive and repulsive forces existing in the atoms of matter, are adequate to produce all the phenomena we witness in the inorganic world, which will be more clearly seen as we proceed in this work.

CHAPTER II.

Heat---Nature and Source Of.



EAT is the effect of a peculiar molecular change of matter, produced by the disturbance of the atoms of which matter is composed. This disturbance is produced in the following manner: Suppose we take two balls of the same size and composed of the same metal, therefore having the same weight. We have previously shown matter to be composed of molecules, and these molecules are made up naturally of two primitives, positive and negative atoms; that solids either take one or two positive atoms to one negative atom. Now we will suppose these balls to be composed of molecules whose constituents are one positive to one negative atom; hence, as one negative to one positive atom satisfies the attraction or affinity of the positive for the negative atoms, and vice versa, consequently their molecules are in a state of equilibrium. Now if this equilibrium is destroyed by the addition of more positive atoms to either ball, there will be a molecular change in the constitution of such ball, thus increased, in positive matter. Should one of these balls be made to contain two positive atoms to one negative (through causes to be hereafter explained,) and the two balls be placed in close proximity, the one containing the greatest number of positive atoms, having more than is required to satisfy the affinity of the negative for them, consequently the positive atoms are loosely held by the attraction of the negative for them, on account of twice the number being present that is required to satisfy such negative

affinity, and through the influence of the repulsive forces of the positive atoms over each other; therefore, a part of the positive atoms will be forced out and imparted to the other ball and surrounding matter.

Therefore, it is owing to the superior number of the positive atoms in a body, in proportion to the negative atoms of that body, which makes it of a greater degree of temperature than one of less positive matter, in proportion to the negative of such body. Thus, in the case just cited, the ball which contains two positive atoms to one negative, will be of a greater degree of temperature than one of equal number of positive and negative atoms, because the ball containing the greater amount of positive matter, being over-supplied therewith, will more readily impart or give up such surplus to other substances, containing a less quantity in proportion to the negative materiality thereof.

Why bodies contain more positive matter at one time than another, will be explained in another place in this work. Why the positive atoms instead of the negative pass from one substance to another in this molecular change of matter, causing a substance to contain more positive matter one time than at another, is from the fact that positive matter is in excess of that of the negative, and it is this excess which produces the transformation of bodies, which will be explicitly shown as we proceed in this work. If the negative matter in the universe was in excess of the positive, then that negative excess would produce the changes in bodies, but as the latter is in excess of the former, therefore, that positive excess in motion is the absolute cause of these molecular changes.

Heat being only the effect produced by the presence of the positive atoms in matter to excess; that is, when the positive atoms, in comparison to the negative atoms in one substance, exceed the amount in materiality to that of the positive atoms in comparison to the negative atoms of any other substance, we say the positive atoms of the former

are in excess of the latter. And hence the term, positive atoms to excess, will be used as denoting a greater degree of heat or temperature of a body.

We will next proceed to notice the following point: Can a substance contain more positive matter at one time than another and be of the same weight, according to the assumption before us? If not, then the position we have here taken is false. For it has been experimentally proven that a heated body (one containing more positive atoms), weighs no more when hot than when cold; that is, any substance, either solid or liquid or even a gas, if heated to any degree of temperature and then weighed, and then allowed to cool and weighed, their weights if taken in a cistern of excluded air, or a vacuum as it is commonly termed, will be the same.

That a substance can contain more positive matter at one time than another, yet weigh the same, may be readily comprehended from the following considerations and conclusions, which are agreeable to and coincide with the two universal laws in nature, as heretofore set forth.

The earth being composed of materials, whose constituents are positive and negative atoms, arranged in different substances according to the laws of attraction and repulsion existing in the atoms of matter, consequently should we have a body to be weighed containing ten positive and ten negative atoms of the same attractive and repulsive forces, and the earth contains likewise the same attractive and repulsive material, and the attractive and repulsive forces are the same in the atoms of matter, such body would have no weight at all, because the attractive and repulsive forces being equal, one would balance the other. But according to the assumption that the attractive forces are superior to the repulsive in the atoms of matter, the attraction of the earth for such substance would be in proportion to the superiority of the attractive over the repulsive forces in the atoms of matter. This bal-

ance of the attractive over the repulsive forces we call the attraction of gravitation; it being the excess of the attractive over the repulsive forces existing in the atoms of matter.

Let us now add to this substance to be weighed one positive atom more, making eleven positive atoms to ten negative atoms, and see if it would weigh any more. We have now added one positive atom having attractive and repulsive properties, but as in the former case the attractive being greater than the repulsive forces in the atoms of matter, necessarily if the earth contained the same amount of matter in negative as in positive atoms, would weigh as much more as the amount of matter added; whether it be negative or positive matter will make no difference. But we find the earth does not contain the same amount of positive and negative matter. For at or towards the centre of the earth we find that the same substance that exists in a solid state at the surface, as iron for instance, would at the depth of 50 or 100 miles become a molten mass, containing twice the amount of positive matter which it would naturally contain at the surface of the earth.

The central portion of the earth, therefore, being a hot mass, must necessarily contain more positive than negative material at that point, and should the rest of the earth contain equal quantities of positive and negative material, this central portion would give a balance in favor of the positive materiality of the earth. Consequently the weight of the addition of one more positive atom to a substance to be weighed, will depend upon the amount of positive or negative material in the earth, as the positive is attracted by the negative and repelled by the positive matter in the earth.

Hence, should we find that the attractive forces of the atoms of matter were $\frac{1}{10000}$ greater than the repulsive, and that the positive materiality of the earth was $\frac{1}{10000}$ greater

than the negative, the attractive and repulsive forces of the earth, over the positive matter in bodies at its surface, would be in equilibrium. Therefore the amount of positive atoms in any substance at the surface of the earth to be weighed, would not change or effect its gravity.

We must therefore conclude, in view of the position above stated, evidenced by the great degree of heat towards the center of the earth, (the explanation of which will be found in another place) that the addition or abstraction of positive matter to or from a substance, does not necessarily add to or depreciate its gravity at the earth's surface.

Therefore it may be said of the positive atoms at the surface of the earth, that their attractive and repulsive forces, so far as concerns the law of gravitation, are nearly balanced, for purposes as will be hereafter seen, which the Great Architect in the creation of the world found necessary to establish, in order to complete so grand, so noble, yet so simple a system of universal laws over matter, producing such infinite results.

On carrying this subject a little further, we find that as this excess of positive matter in the earth over the negative materiality produces equilibrium of the earth's attractive and repulsive forces, as concerns the positive matter at its surface, consequently as you decrease the gravity of positive matter at such point, you necessarily increase the gravity of the negative materiality in substances at such surface of the earth; for greater the amount of positive matter in the earth, greater will be the gravity of negative matter produced by the increase of matter which attracts the negative. Hence, as you increase the positive matter of the earth, greater will be its attraction for negative matter at its surface, and consequently negative matter at such surface will weigh more than it otherwise would, if the earth contained equal quantities of each kind of matter. The increase in gravity depending on the amount of the excess of positive matter over that of the negative ma-

teriality of the earth, hence as we decrease the gravity of the positive matter, we likewise increase the gravity of the negative matter, and in the same proportion. Therefore, in this as in all of God's works, where there is a loss to one substance, materiality or power, there is a corresponding gain to another; therefore, nothing lost.

Hence we find written intelligibly in the phenomena of nature:

First—That in the weight of any substance at the surface of the earth, the positive atoms in such substance bear no appreciable part in the gravity, or weight, of that substance.

Second—That the negative atoms in a substance, at such surface of the earth, determine the gravity, or weight, of the same in all cases.

SECTION I.

THE EARTH'S CENTRAL HEAT.

The existence of the earth's central heat is so well established in the minds of all scientific men, the proof of its existence only needs a passing notice.

As evidences of such heat at the centre of the earth, or towards the same, we find that as we descend into the earth from its surface, and pass beyond the limits of the influence of solar heat, the temperature continually rises, it being about one degree of the thermometer for every fifty feet of descent. Supposing the temperature to increase according to this ratio, at the depth of two miles water would be converted into steam; at four miles tin would be melted; at five miles, lead; and at thirty miles almost every earthly substance would be reduced to a fluid state.

Other evidences of the earth's central heat are found in the volcanos and their eruptions, and also in the earthquakes or subterranean convulsions, which shake and tear

the earth asunder like the explosion of a steam boiler. These convulsions are accounted for on the consideration that the matter of the surface of the earth, as water in its concentrated condition, if permitted to fall upon this hot mass of lava towards the center of the earth, will be converted into steam and caused to occupy more space; and if the volcanoes (which are safety-valves to the earth), are not sufficient to relieve the pressure thus produced, an eruption of some portion of the earth's surface will be the result. This being sufficient to show the existence of such central heat, we will next notice the cause of such heat.

The cause of the earth's central heat grows out of the excess positive matter in nature. Now it is evident that if there is an excess of positive matter over the negative materiality of the earth, and the repulsive forces of matter we will say are $\frac{1}{100000}$ less than the attractive, it follows that the earth will take this $\frac{1}{100000}$ excess of positive matter and will retain no more, should it be added, any length of time. It will retain the $\frac{1}{100000}$ because the earth has an attraction for it, but when you get above that amount, then it will have repulsion to that which is added above this excess of $\frac{1}{100000}$, because as we increase the amount of the material in a substance which is repulsive to itself, we in the same proportion increase the repulsive capacity of that substance to such matter thus increased.

The next question to be considered is, where is this excess positive material situated in the earth. It will be located of course, the greater amount thereof, at or towards the center of the earth, at that point which would best satisfy the earth's attraction for it, taking into consideration the pressure of matter upon matter. That is, in the consolidation of matter by pressure, the atoms which are more loosely held than others will be the ones first driven out by such pressure, which are the excess positive ones. Hence, were it not for this great pressure to which the matter of the earth is subjected, causing it to be more dense at

the center than at any other point, the excess positive atoms would be concentrated at the center of the earth, because this point would best satisfy the attraction of the earth as a whole for them.

How far this pressure would cause the excess positive atoms to be forced out of the center towards the surface of the earth, I shall not attempt to answer. But doubtless at the depth of thirty miles at the utmost, from the surface of the earth, the greatest degree of heat will be found, and it is questionable whether earthy matter there could exist in a liquid state under thirty miles of material pressure of earthy matter.

However, it is evident that towards the center, at some point or other, the greatest degree of heat will be situated. Because all matter which is susceptible of being attracted, and like positive matter possessing the power of penetrating or pervading all other matter, or substances, will concentrate towards the center of the earth, and as the addition of positive atoms not to exceed the negative over 100000 to the earth, have gravity or weight, consequently this excess would concentrate towards the earth's center, and the greater amount would approximate the point where the attraction of the earth for this excess is balanced by the pressure of the mass of matter intervening this point and the surface of the earth. That is, the greater degree of heat would be above the point where the pressure would have as much force to keep out, as the earth's attraction would have to draw in the said excess of positive matter. Hence the greatest degree of heat will be between this point and the surface of the earth. Consequently the earth to the depth of probably from thirty to fifty miles from the surface, is the only part materially affected by this excess of positive matter, the remainder towards the center being nearly of the same degree of temperature and a solid mass. Therefore the attraction of the negative materiality over positive matter being in excess of the re-

pulsive forces of positive matter over their respective atoms, will cause a concentration of positive matter at this point.

Inasmuch as this excess of $\frac{1}{100000}$ is concentrated towards the center of the earth, through the influence of gravitation, the earth's central heat will remain unchanged and uniform, with a constant increase as we go below the earth's invariable stratum; the surface of the earth only being subject to periodical changes and fluctuation in temperature, produced by the heat from the sun and other sources, which will be explained as we proceed with this treatise. This is not in variance with the idea that the earth has been cooling since its creation, or down to 2,000 years ago, but it is doubtless down to the lowest point agreeable to the laws above stated.

SECTION II.

RADIATION OF HEAT.

We have seen that the earth in taking this excess of positive matter has taken all she has attraction for, and therefore the attraction and repulsion of the earth, as regards the positive matter at its surface, are in equilibrium. Hence, were it not for the molecular changes produced by the influence of the sun and other foreign bodies over the earth, the surface of the earth would fall to a certain degree of temperature and remain there forever. But through the influence of the sun, principally, different parts of the earth's surface, at different times, become heated far above this certain degree of temperature and consequently temporarily made to contain more positive matter than the earth has attraction for. Therefore, in the absence of the sun's rays a certain portion thereof is repelled or driven out of the earth's surface, through the influence of the repulsion of the positive atoms over each other.

This molecular change is commonly termed the radiation of heat. All substances which contain more positive matter than is required to balance the attractive forces of that substance with its repulsive (as regards the excess positive matter), will radiate the excess above that amount, producing heat to surrounding matter or substances; that is, all bodies containing an excess of positive matter above that which balances its attractive and repulsive forces, will continue to radiate the same until such bodies are reduced to equilibrium, when they will cease to give out any more heat. This positive excess we have heretofore supposed satisfied the earth's affinity for positive matter, and if she is forced temporarily to take more it will not be retained but repelled therefrom as above. After a heated substance is reduced down to this excess, it ceases to give out any more positive matter, and that remaining will be in a latent state, combined with the negative atoms. This latent condition of positive matter has been termed Latent Heat.

It is evident that a substance, or that portion of the earth's surface which contains a greater excess of positive matter than above, would throw off this excess, because according to the assumption that the increase of positive matter to the earth of $\frac{1}{10000}$ balances the attractive and repulsive forces of the earth, as regards the positive matter at its surface (the repulsive forces having been considered $\frac{1}{10000}$ less than the attractive). Consequently as this increase of $\frac{1}{10000}$ just balances the attractive and repulsive forces, as regards the positive atoms at the surface of the earth, therefore a further increase of positive matter to the earth's surface and substances thereat, will increase their repulsive capacities to other positive matter, as such matter repels its own kind and does not attract the same.

Consequently as we increase the excess of positive matter above this $\frac{1}{10000}$, we at the same time and in the same proportion increase the repulsive forces of the positive mat-

ter in that substance. Hence, greater the increase, greater will be the radiation of the said excess of positive matter.

Through the influence of the sun, principally, the surface of the earth is kept constantly above that degree of temperature which the $\frac{1}{100000}$ excess of positive matter would make it, except perhaps at the poles of the earth. Therefore, at all other parts of the earth's surface this radiation goes on at all times, and from all substances, whether their temperature be the same or different from that of surrounding objects; therefore the temperature of a body falls when it radiates more positive matter than it absorbs; its temperature is stationary when the quantity emitted and received are equal, and it grows warmer when the absorption exceeds the radiation.

Inasmuch as the excess positive matter is thus propagated through space by radiation in straight lines, its intensity will vary according to the same laws which govern the attraction of gravitation; that is, inversely as the square of the distance intervening the source of repulsion, showing that the repulsion of matter by radiation, as above, follows the same laws as all other kinds of repulsion, and consequently from the same source, that which is manifested in the atoms of all matter—there being but two forces in nature, a repulsive and attractive force existing in the atoms of all matter. Therefore, in all the operations carried on in nature, these two forces are concerned and have their pervading influence over matter.

SECTION III.

LIQUIFACTION.

In the commencement of this work we learned how solids, liquids and gases were formed in their natural state. It becomes our province now to show how a solid may be converted into a liquid by artificial means, by the application of heat. We noticed there that the difference between

a natural solid and a natural liquid is in this: The natural liquid molecule takes more positive atoms than the solid, because of the greater attraction of the negative atoms for the positive atoms in the liquid, than those of the negatives of the solids, and by that means weakens the cohesiveness of the liquid molecules.

It can be readily seen upon this assumption, how a negative which has three or four times the attraction for the positive atoms than others, can take more positive atoms, because the negatives will take of the positive atoms according to their attraction for them. But in the production of liquids from solids by artificial means, the solids have already taken of the positive atoms to the utmost of their ability, according to the forces existing in such substances, and, therefore, if such solids are made to contain any more positive material than they already possess, it must be through the influence of foreign forces operating upon them.

Artificial liquids as well as all others are produced, as will be shown, by the superior number of positive atoms present in a liquid surrounding the negative atoms, and a solid which contains alternately one negative to one positive atom, can be made to assume a liquid or even a gaseous form, by the addition of more positive material, causing the negative atoms to become partially or totally enclosed with positive matter, therefore weakening or totally destroying its cohesive attraction.

The question now arises, how can a substance contain more positive material at one time than at another, inasmuch as the negative atoms have the same attractive and repulsive force at all times.

Were it not for foreign influences such as the sun, combustion, radiation, etc., the positive matter would be distributed throughout the whole earth in accordance to the forces operating in the atoms of matter, and all matter would be at rest. But the sun, principally, as we have al-

ready noticed, is the great source of the life and activity of matter, producing the molecular changes of light and heat to the earth.

The sun produces motion to matter, which causes light and heat. Light and heat is positive matter in motion, which will be shown in another place. Radiation is another source of motion to positive matter in excess, as we have already seen. Combustion, to be explained hereafter, is another source of motion to positive matter. Where the positive atoms are set free from a substance by combustion, condensation, friction, or in any other way, there is motion given to the liberated positive atoms through their own repulsive forces. The positive atoms at the surface of the earth having no weight, are consequently forced to rise by atmospheric pressure, which is another cause of motion to positive matter.

Were it not for this motion thus given to positive matter, a natural solid could never be made to melt or liquify. But through this motion thus given to the positive atoms, connected with the powers or forces originally imparted to the atoms of matter, liquifaction is produced.

Two requisites are necessary in order to raise the temperature of a substance: 1st—The presence of a surplus of positive atoms; 2nd—Motion to those atoms towards the substance. And when this motion subsides, or when it is less than the excess of the repulsive forces of the positive atoms over the attraction of the negatives for such surplus positive atoms in a substance, then if a substance contains more than it can retain, it will begin to radiate the same, producing radiant heat. The amount which any substance can retain has heretofore been considered to be an excess of about $\frac{1}{10000}$ above the negative materiality of such substance.

The motion given to positive matter in combustion and condensation is due to repulsion of the mass of liberated atoms. Thus should ten thousand positive atoms be set

free from a burning substance at once, being in close proximity to each other, you can imagine the result—they would be repelled in all directions from the burning body; but through the pressure of the atmosphere their general course would be upwards, the air being heavier would cause them to rise. Hence, if you wish to heat a substance or body it is most economically accomplished by placing the same directly above the flame.

SECTION IV.

CONDENSATION.

The reduction of matter into a smaller compass by an external or mechanical force, is generally attended with an evolution of heat, by forcing out the excess of positive matter therein contained. This may be shown by placing a piece of tinder in a tube and suddenly compressing the air contained in it by means of a piston. The air on being condensed parts with its latent positive atoms in sufficient quantity to set fire to the tinder at the bottom of the tube. Air has been condensed twenty-seven times by pressure and still retain its gaseous state. In this condensation the positive atoms are squeezed out, and only part of the positive atoms remaining with the negative atoms which the air originally contained.

It may be asked why the negative atoms are not equally forced out by pressure, the same as the positive atoms. It is from the fact that the positive atoms are much smaller than the negatives of the gaseous molecules, and therefore find their way into and through the tube by conduction, the positive and negative atoms of the tube being nearly of the same size; but the negative atoms of the molecules of the air and other natural gases are very much larger, as we have seen at the commencement of this work, therefore the positive atoms will pass through the sides of the tube, while the negative atoms will not, but re-

main in the tube, and when the pressure is removed they will attract to themselves positive matter from the surrounding substances to satisfy their affinity again, and thus be reinstated to their original form and rarity which they first possessed.

Gases may be condensed to a certain extent without removing the positive atoms, because the molecules of gases being completely in a positive condition superficially, that is, the negative atoms are perfectly enveloped with positive atoms, consequently the repulsive properties of the molecules in their natural state would have a tendency to keep them from touching each other, and hence a space would intervene the molecules, and the gas would bear a certain condensation without removing the positive atoms.

The condensation of all natural gases produces the same results, so far as the evolution of heat is concerned, showing that the laws which hold them in their natural state are universal, and are the same in all gases.

The condensation of solids by pressure, causing them to occupy less space, produces an evolution of heat by squeezing out the excess positive atoms, they being the first and only ones which can be driven out by pressure from a solid.

A substance which contains positive matter to excess holds that excess more loosely than positive matter not in excess, consequently that will be the first matter to be forced out by such pressure. And it is the only matter which can be forced out of a solid atomically, because after reducing the positive atoms to the same amount of matter contained in the negative atoms of the solid, the positive and negative atoms will be equally retained by their mutual attraction for each other, and the remaining positive atoms will be held in combination with the negatives with greater tenacity, and the solid will often become harder and more brittle.

SECTION V.

FRICTION.

The evolution of heat from friction is not due exclusively to the condensation of the surface matter of the solids rubbed together; there may be a condensation of the solid to a certain extent, resulting in the production of heat, yet there may be a continual evolution of heat by friction, even without materially changing the density of the solids, so long as the friction is kept up, and therefore cannot be due to the condensation of the solids as in the former cases cited. This being the fact, it has induced some to consider that heat is not due to the addition or abstraction of matter to or from a substance; or in other words, a heated substance contains no more matter when hot than when cold.

Heat from friction not being due to the condensation of the solids rubbed together exclusively, therefore we must look to other causes for the solution of this phenomenon. We have already seen that heat is evolved by the condensation of the air. This fact may help us in this solution. Let's see! The air being present while the friction is performed with the solids, therefore must intervene the solids, and by pressure and rubbing the solids together a condensation of the air will be produced, consequently an evolution of heat. This is adequate to explain the phenomenon.

Let the reader imagine the existence of millions of minute molecules of the air intervening two solids which are to be rubbed together, and these molecules superficially in a positive condition; the negative atoms being completely enveloped with positive atoms, the source of all heat, when liberated and put in motion. Now if these solids, with such intervening molecules, should be forcibly rubbed together, what would we reasonably expect would be the result?

We should expect that the positive atoms would be

forced off from the negatives by this continual grinding of the molecules under the pressure and between the frictionizing solids. And the positive atoms thus separated from the negatives, would by the motion imparted to them pass into the solid and cause an increase of temperature to the same. The negatives of the gaseous molecules thus being partially deprived of their positive atoms, will from the surrounding matter imbibe and attract to themselves a new recruit as soon as the pressure from them is removed, and by passing the pressure again over them the result will be the same as before, causing the temperature of the solids to continue to rise. This will be the case while the process is continued, causing the solid to possess a great degree of heat. And hence to whatever extent the process may be carried on, the solids will never cease to give out heat. All kinds of friction will produce similar results by rubbing or forcing one solid against another, even from ice, and even under water heat may be produced and the water made to boil.

Hammering will produce like results as friction, by condensing the solid, or the air which rests on the surface of the solid, which comes under the condensing force of the hammer.

Air is not the absolute requisite in the production of heat by friction, for heat can be produced by friction under a jar with the air removed or expelled; nor will it make any difference as to the effect produced by friction, whether the air is or is not present, if the positive matter is supplied sufficiently and allowed to come between the frictionizing solids and take the place of the air, for it is the positive matter in motion which produces heat and causes the rise in temperature of bodies, not negative matter. And if this positive matter intervenes the frictionizing solids, it will be pressed or forced into the same, causing a rise of temperature.

Now if we can show that this positive matter is sup-

plied in abundance to the solids as above, a solution of these phenomena is easy. We have seen in the foregoing pages that the excess positive matter is at all times and from all substances constantly being radiated in all directions through the air and water, etc., from earthy matter. The general course of heat, however, is upward, because when the radiant force is spent the atmospheric pressure will cause it to rise, such positive matter having no gravity at the surface of the earth, and will either be taken up by the molecules of air or forced upward in an uncombined state by the pressure of the atmosphere. The atmosphere thus has a tendency to crowd out the excess of positive matter thus liberated.

And if the air should be withdrawn from a jar, the excess liberated positive atoms would be forced or crowded into that jar by atmospheric pressure. Hence, there can be no such thing as a vacuum in nature, especially at the surface of the earth. If you remove the air you only make room for other matter, as the space will be filled by positive matter.

The fact that a certain degree of cold is produced by suddenly removing the air from space, and also by rarifying the air by removing the pressure, explicitly shows that there is a molecular change in matter. And the fact that the excess positive matter in motion is susceptible of pervading all matter and substances, and that this positive matter is moved by the pressure of the atmosphere, therefore it is only reasonable to conclude that the space vacated of air is occupied by positive matter, and therefore a jar vacated of air becomes filled with excess liberated positive atoms.

It might be thought, by the unconvertant student of the nature of the laws operating in the atoms of matter, as set forth in the commencement of this chapter, that a jar vacated of air and filled with the excess liberated positive atoms, would be of a great degree of heat merely by the

presence of such atoms, inasmuch as the positive atoms are the source of all heat. Under the head of Liquifaction you will find that it was determined that although liquifaction was caused by the excess positive atoms, yet no substance could be melted, or liquified, by merely the presence of positive atoms in a liberated state, and that no substance could be made to take a single atom more than it already contains, unless such liberated positive atoms are put in motion; motion to the excess positive atoms being an absolute requisite in order to produce heat from the same. Hence, if the hand should be thrust into a jar containing liberated positive atoms, no sensation of heat would be produced, unless the atoms were in motion towards your hand, as it is impossible for them to enter your hand, or any other body, without motion. And as the positive matter in the jar thus vacated of air, is necessarily in a quiescent state, consequently no heating effect can be experienced therefrom. The atmospheric pressure being equal on all sides would balance the repulsive forces of the positive atoms, and such atoms would be at rest, and therefore no heating effect will be produced from them while in that state.

SECTION VI.

EXPANSION AND CONTRACTION.

Expansion is caused by the addition of the excess positive matter to, and Contraction by the abstraction of the same from a substance. Solids expand the least, liquids next and gases the most by the addition of such matter thereto, and the reverse is the case on the abstraction of such matter. The same degree of heat expands the same solid, liquid or gas under like circumstances precisely the same though applied ten thousand or endless times, showing that the atoms of matter follow certain universal laws, which are uniform and unchangeable. That the considera-

tions laid down at the commencement of this work coincide with and are agreeable to the phenomena of nature, as regards the expansion and contraction of matter, is here exemplified and shown.

The expansion is the greatest in those bodies that are the least influenced by the attraction of cohesion, therefore gases expand the most by the same degree of heat, because their molecules are the least, if any, influenced by the attraction of cohesion, as has been heretofore shown. Therefore the gases will expand uniformly, being $\frac{1}{400}$ of the bulk which they possess at 32° for every degree above that point, and contract in the same proportion for every degree below that point. Thus 490 cubic inches at 30° would so expand as to occupy an inch more space at 33°, still another inch at 34°, and at the same rate for higher temperatures; and the same quantity would contract by cold, or withdrawal of heat, so as to occupy an inch less space at 31°, two inches less at 30°, and so on for lower temperature. The law is the same for steam and other vapors.

Gases do not expand mechanically, but physically; yet the molecules of all elementary substances expand, or are increased mechanically by the addition of positive matter. (See page 16.) That is, the addition of one positive atom to any molecule increases the size of the same just one positive atom larger, yet its physical effect is different as regards the expansion of the gases, as can be readily seen. For the addition of one positive atom to each gaseous molecule, inasmuch as the molecules are already in a positive condition superficially, therefore will increase the repulsive capacity of such molecules to such an extent as to make them occupy many times the space, which all the positive atoms added could possibly mechanically do. Hence, gases do not expand mechanically; but as their molecules are already in a positive condition, and therefore repulsive to each other, the addition of more repulsive posi-

tive material has a tendency to expand gases many times beyond what would be the mechanical effect of the simple compilation of matter upon matter. And as a minute molecule of a gas, on the addition of one positive atom mechanically, only increases that molecule just the size of one positive atom larger, yet the space the molecule has to occupy in the formation of a gas is many times larger, and the specific gravity of the gas becomes less, by reason of such expansion beyond what would be its mechanical effect, should we consider the weight of the positive atoms nothing.

In gases the expanding effect of heat is unaffected by any disturbing cause; there is no cohesion remaining to impede its operations, hence a certain increase of heat effects all gases alike, and it matters not how hot or how cold a gas may be a certain increase of heat produces the same increase of volume in every case.

In solids and liquids, however, it is different, the expansion which occurs is but the result of the opposing forces of attraction and repulsion, and hence the amount of expansion depends not only on the quantity of heat which is applied, but also on the power of cohesion by which it is resisted and which will depend upon the nature of the body. Consequently, every liquid or solid expands in a degree which is peculiar to it.

The effect of cohesion upon the expansion of solids and liquids may be illustrated in the following manner: Let us call the cohesive attraction of a certain substance, for example, 8. Now should we apply to it a quantity of heat which will expand it through a space which we will call 1, and will diminish its cohesion from 8 to 7. If then we apply another quantity of heat exactly equal to the former, it will not have to contend against a cohesion of 8 but of 7, and consequently will be able to produce an expansion of more than 1, say $1\frac{1}{2}$, and it will reduce the cohesion more than it did before, as from 7 to $5\frac{1}{2}$. If then another equal

quantity of heat be added, it having still less opposing force to overcome, will still more powerfully reduce the cohesion from $5\frac{1}{2}$ to 4, and the increase of volume instead of $1\frac{1}{2}$ becomes 2. In solids and liquids the rate of expansion increases thus with the increase of temperature. The weakening effect of the addition of the positive atoms to a solid to the cohesion of its particles, will be found illustrated and explained under the head of Liquefaction.

Great simplicity is shown in the dilation of liquids by their contraction after being brought to the same molecular condition; that is, to the same cohesive state. This may be nearly done by heating them to their boiling point, for the attraction of the molecules for each other then is nearly overcome by the superior number of the positive atoms which surround the negative atoms in each molecule. Thus alcohol boils at 173° ; water at 212° ; sulphuret of carbon at 138° ; and sulphuric ether at 96.3° ; and taking 1000 volumes of each at their boiling points and allowing them to cool they contract as follows:

By Cooling Through	Water Contracts	Alcohol Contracts	Sulphuret Carbon Contracts	Ether Contracts
18°	6.61	11.40	12.00	16.20
36°	13.15	24.30	23.80	32.00
54°	18.85	34.70	35.04	46.40
72°	24.10	45.64	45.70	58.70
90°	28.58	56.00	56.26	72.00
108°	32.40	65.90	66.20	

By this means we find a very intimate relation between alcohol and sulphuret of carbon, two fluids remarkably different in their specific gravities and their chemical properties.

Many liquids possess the properties of contracting, by reduction of temperature only to a certain point, below which, if the cooling be continued, they expand. As the

volume at this temperature is the least, it is called the point of maximum density. This peculiarity was first recognized in water, but has since been discovered to exist in many other fluids and in a more remarkable degree. This remarkable phenomenon of nature is due to the manner in which the molecules become united to each other on consolidation, through the attractive and repulsive operations of the positive and negative atoms of such molecules, which will be explained under the head of Crystallization.

The reader will observe that by thus adding more positive material to the molecules of substances while the negatives of each molecule remains the same, that through the influence of the repulsive properties or forces of the positive atoms over each other, that a great amount of repulsive force can be obtained—such as is produced in the conversion of water into steam, and by the expansion of the gases. The force thus exerted is a repulsive force, similar in all respects to that of two magnets when their similar or like poles are brought into proximity to each other; like poles repelling each other.

And thus in the molecular change of matter, when the atoms of the same kind are so arranged in the molecules so that the atoms of the same kind in one molecule have to approximate those of the same kind of the others, nearer than the other kind of atoms (see Gases), there will be an expansive and repulsive force exerted among the molecules over each other as is manifested in steam, producing a strong motive power. This causes the expansion of substances. And as the natural gaseous molecules are by nature in a positive repulsive state superficially, the addition of more positive material must necessarily increase the repulsive and expansive capacity of such molecules over each other far beyond what would be the effect of the same amount of positive matter added to the molecules of liquids; therefore, such gases are the most economically

adapted to the production of motive force in mechanism, requiring less fuel to produce the same power by heat.

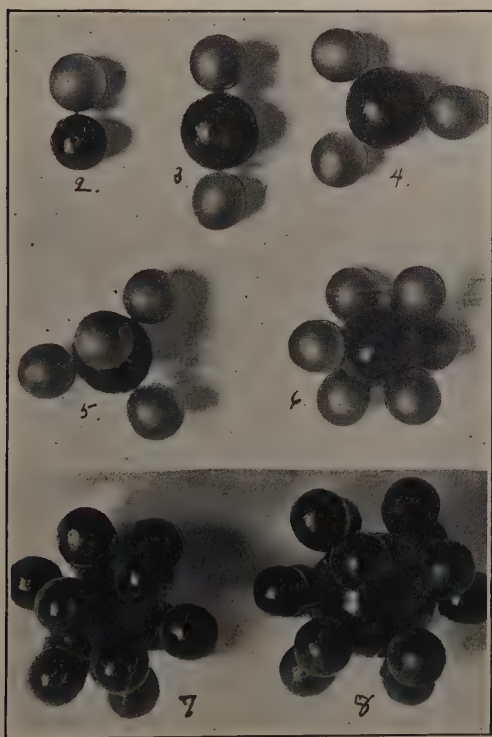
SECTION VII.

SPECIFIC AND LATENT HEAT.

Heat being the effect of the positive atoms in motion, and as we have seen that there could be no heat without motion, and this to the positive matter in nature, therefore the term latent heat is incorrect. But there can be latent positive and negative atoms. And as the positive atoms in motion cause the sensation of heat, where the term latent heat has been used in science, we will use in its place the term, Latent Positive Atoms.

Were it not for foreign influence all matter would be at rest, and the negative and positive atoms would be in a latent state. The positive and negative atoms would be so arranged throughout the earth as would best satisfy the forces which exist in the atoms of matter, and at the surface of the earth all substances would contain nearly the same proportion of positive material to that of the negative, yet not quite as has been shown at the commencement of this work, under the head of Elementary Substances.

The opposite plate will suffice to illustrate this point, thus: No. 1 represents a molecule of a solid containing 1 positive atom to 1 negative atom, both the same size; No. 2 represents a molecule of a solid containing a negative atom $1\frac{1}{2}$ times larger than the negative of the molecule 1, yet can take only 1 positive atom; No. 3 represents a molecule of a solid having a negative twice as large as that of the 1st molecule, therefore takes 2 positive atoms; No. 4 represents a molecule containing a negative $2\frac{1}{2}$ times larger than that of the No. 1 and consequently will not take only two positive atoms, unless there is an excess of positive



matter in nature, but as there is therefore will take 3 positive atoms. This will make the relative amount of positive and negative material in the four molecules as follows: The 1st would contain an equal amount of positive and negative material; the 2nd, the negative a little the more; the 3d, the same amount; and the 4th, the positive material is the larger, which would make their negative material as follows, commencing with the 1st, thus: $\frac{8}{6} + \frac{7}{6} + \frac{1}{6}^2 + \frac{1}{6}^5$, and these together would equal $\frac{40}{6} = 6\frac{4}{3}$, which would represent the matter of the negatives and 7 that of the positives, as there are 7 atoms of the size of the first negative. In the first molecule the negative and positive material is the same, and likewise in the third; but in the second the negative is greater, while in the fourth the positive is the greater. This shows that the latent positive atoms in the molecules of matter are not the same in number nor proportion to that of the negatives in all cases, and if not in the molecules, therefore will not be in the various substances which constitute the materiality of the earth.

Let us now notice the effect of specific heat over the molecules thus arranged; specific heat being the relative quantity of heat necessary to raise the temperature of a body through a certain number of degrees as 1000, for instance.

We will suppose that in order to raise the molecule 1 through 1000 degrees of heat, it is necessary that we should add to it 1 positive atom more, making it contain temporarily 2 positive atoms. Now to bring molecule No. 3 to the same repulsive positive condition, so that it will radiate the same proportion of heat to that of the 1st molecule, we will have to add to it just 2 positive atoms, making said molecule temporarily contain 4 positive atoms, because the negative thereof is just twice as large as that of the 1st molecule; the two molecules originally containing equal amounts of positive and negative material, which is not the case with molecule 2 and 4, it taking more positive

matter to bring molecule 2 into the same repulsive condition in proportion to that of the 1st and 3d, because the molecule does not contain the same amount of positive to that of negative material, the negative being $\frac{1}{6}$ greater than the positive. Consequently it will take 1 atom and $\frac{2}{3}$ of positive material to bring it to the same repulsive condition to that of molecule 1 and 3, while as the positive material of molecule 4 is $\frac{1}{2}$ positive atom in excess of the negative material of the same, hence will take an addition of just 2 positive atoms more to bring it into the same molecular repulsive condition. Hence the molecules now stand after passing each respectively through 1000 degrees of heat as follows: The 1st, the positive 2 to 1 of the negative; the 2nd, $2\frac{2}{3}$ positive to $1\frac{1}{6}$ negative; the 3d, 4 positive to 2 negative; the 4th, 5 positive to $2\frac{1}{2}$ negative. They stood originally, the 1st molecule, 1 positive to 1 negative; the 2nd, 1 positive to $1\frac{1}{6}$ negative; the 3d, 2 positive to 2 negative; and that of the 4th was 3 positive to $2\frac{1}{2}$ negative.

This shows that the specific heat of molecules 1 and 3 are in proportion to the positive and negative material of each molecule respectively and therefore in proportion to their molecular constitution, which is not the case with either molecule 2 or 4. This shows that the specific heat of substances may in some instances be in proportion to their molecular constitution, while in other cases it may not be, for as the molecules of different substances are thus affected by the increase of temperature as above, so will the substances which are formed from such molecules be affected, and hence the specific heat of different substances will have no absolute analogy to the forces which exist in the atoms of matter, although there may be in some cases a striking and very intimate relation between the specific heat of a substance and its chemical and molecular constitution. And there would be in all cases should the molecules of all substances contain negatives having the same proportion

to each other, as regards their positive atoms as in molecules 1 and 3 above described; they would then follow the same laws, but as it is no proportion or rule will apply in all cases.

We find in passing the above molecules through 1000 degrees of heat, allowing one positive atom to be equal to 1000 degrees, that their specific heats will be as follows, as may be seen in the table, thus:

Molecule 1 takes 1 Positive Atom=1000 Degrees.

Molecule 2 takes $1\frac{1}{3}$ " " =1333 "

Molecule 3 takes 2 " " =2000 "

Molecule 4 takes 2 " " =2000 "

As the atoms of matter cannot be divided, therefore perhaps molecule 2 should have 2 positives=2000 degrees.

Should each molecule be passed through 2000 degrees of heat, their specific heat will be as follows, just double the amount as shown in the above table:

Molecule 1 takes 2 Positive Atoms=2000 Degrees.

Molecule 2 takes $2\frac{2}{3}$ " " =2666 "

Molecule 3 takes 4 " " =4000 "

Molecule 4 takes 4 " " =4000 "

On comparing the two tables we find that the specific heat of the molecules increases with the increase of temperature. Hence, with the precedence before us we are enabled to arrive at the following conclusions, viz:

1st—That the specific heat of substances, as well as the molecules of matter, are not in proportion to the latent positive atoms in such substances, or the molecules thereof, especially in some cases, yet in other cases it may be or approximate to it; hence there is a connection in some cases of the specific heat of substances with their chemical and molecular constitution.

2nd—That the specific heat of substances increases with their increase of temperature.

Actual experiment has determined that the specific heat

of different substances increases with the increase of temperature, which is agreeable to the laws manifested in the atoms of matter as determined above. Dulong and Petit have found that the specific heats, calculated from the change of temperature from 32° to 212 and from 32° to 572 , differ as in the following table:

Substances	Specific Heat From 32° to 212	Specific Heat From 32° to 512
Mercury	.0330	.0350
Antimony	.0507	.0549
Silver	.0557	.0611
Copper	.0949	.1013
Platinum	.0355	.0397
Iron	.1098	.1218

Dulong also discovered an intimate connection between the specific heats of bodies and their chemical molecular constitution, which is also agreeable to and in accordance with the laws as determined from the molecules of different substances, as has already been considered.

The following is a table showing such connection. If we take the specific heat of any substance given in the table and divide the number 3.1 by it, we obtain a series of numbers which are found to be either the chemical equivalent of such substances, or to stand in some remarkable simple relation to those equivalents, thus:

Substances	Specific Heat	$3.1 \div$ By Specific Heat	True Equivalent
Lead	.031	100.0	103.6
Tin	.056	55.4	57.9
Zinc	.095	32.6	32.3
Bismuth	.030	100.7	71.0
Carbon	.024	12.9	6.1
Iodine	.054	57.4	126.3
Phosphorus	.188	16.5	31.4
Silver	.057	54.4	108.0

In the first division of this table the quotient approximates so near the true equivalents, that were it not for the unavoidable errors of experiment, they would doubtless coincide with the true equivalent. In bismuth the result is $1\frac{1}{2}$ times the true equivalent; in carbon it is double; in iodine, phosphorus and silver it is one-half of the true equivalent. This illustration could be extended, the number being only intended as examples of the fact.

The above are simple substances, but it has been shown by Nanman and Avogadro that compound bodies are subject to a similar connection between their equivalents and their specific heats, the connecting dividend being no longer 3.1, but a different number for each class of bodies.

Thus 10.4 being divided by the specific heat of the following carbonates separately will produce nearly their respective equivalents. Thus should 10.4 be divided by the specific heat of carbonate of lime, which is .2044, the quotient will be 50.9, nearly the true equivalent 50.6; and so of carbonate of iron, carbonate of zinc and magnesian limestone. For certain sulphates the number appears to be 12.4, and for certain metallic oxides the number is 5.4.

These investigations show that there is a simple proportion existing between the specific heats of simple and also compound substances with their chemical equivalents.

This is also agreeable to the laws which exist in the molecules of substances as heretofore shown; thus in molecules 1 and 3 their specific heats are in the same proportion to each other as regards their latent positive and negative atoms, hence their specific heat will represent their physical forces incorporated in their molecular constitution, and the two molecules will be in the same class.

Molecule 2 will represent another class, and all molecules of similar specific heat representing the constitution of the molecules in the same proportion as the specific heat of molecule 2 does, will be in that class. And so of molecule 4, which will represent another class.

These would represent three classes of the simple substances, and on the combination of different molecules of different specific heats the specific heat of the compound will necessarily partake of the nature of the molecules of which it is formed; hence, the specific heat of the compound will be unlike either one of the constituents, consequently a different proportion will exist in compound bodies than that found for simple bodies.

That the chemical affinity of simple substances for each other and their union to form compounds, is the result of the attractive and repulsive forces which are imparted to the atoms of matter (which will be shown in its proper place), and as specific heat is controlled by these laws, consequently there will be a connecting link between the chemical equivalents and the specific heats of different substances, especially in many instances, as shown in the foregoing pages, it being the natural result of those forces which universally govern and control all matter.

CHAPTER III.

Natural and Artificial Gases Considered.



WE have seen that the natural gases are formed from molecules the negatives of which have so strong affinity for positive matter, that such negatives become completely enveloped with positive matter, and therefore such gaseous molecules are positively repulsive to each other. The artificial gases are also temporarily in this state, brought into this state through the application of heat; hence their molecules are repulsive to each other and also to other gaseous molecules excepting in a chemical point of view, which will be considered under that head.

The main difference between the natural and artificial molecules of gases is in this: the artificial gaseous molecules being produced from solids or liquids will not remain in a gaseous state any longer than the force which keeps them in a gaseous state is kept up. When this subsides, they will fall back into their natural state, because the negatives of solids or liquids having less attraction for the positive atoms than the negatives of the natural gases, therefore cannot retain that amount of positive material which causes such substances to exist in a natural gaseous state.

To show that the same forces exist in the natural as well as in the artificial gases, the following table is annexed, which explicitly determines this matter, where it may be seen that the specific gravity of all natural as well

as all artificial gases have an absolute connection. Thus, should the specific gravity of each gas be divided by 137.6 and multiplied by the equivalent volume with which the gases unite, it will produce numbers corresponding with their atomical weights, which is shown in the following table:

Substances	Specific Gravity	Equivalent Volume	Sp. Gravity ÷ by 137.6 × Eq. Vol.	Equivalent Weight
Chlorine	2454.0	2	35.60	35.46
Fluorine	1296.0	2	18.96	19.00
Oxygen	1102.6	1	8.00	8.00
Hydrogen	68.8	2	1.00	1.00
Nitrogen	976.0	2	14.18	14.00
Carbon	825.6	1	6.00	6.00
Sulphur	6648.0	$\frac{1}{2}$	16.10	16.00
Phosphorus	4327.0	1	31.44	31.36
Iodine	8701.0	2	126.48	126.88
Bromine	5390.0	2	78.39	78.39
Arsenic	10362.0	1	75.30	75.00
Mercury	6969.0	4	202.64	202.86

This table shows that the numbers thus obtained in many cases are the same as their equivalents, and in all cases the difference is so small that it is very evident, should their specific gravities be definitely determined, the quotients thus obtained would be the numbers which should represent their equivalent weights. Hence should all substances be converted into a gas and their specific gravities ascertained while in that state, their specific gravities thus obtained would determine their equivalent weights, connected with their equivalent volumes entering into combination.

This law not only holds good with the simple, but is equally prevalent in the compound bodies. Thus we may take any compound body as nitrous oxide for instance, and take as many specific gravities of each elementary substance as the equivalent volumes indicate, add them to-

gether and divide the sum by the equivalent volumes which the compound gas occupies and the product will be the specific gravity of the gas, thus: NO—nitrous oxide—being composed of 2 volumes of nitrogen and 1 of oxygen, therefore we take 2 specific gravities of nitrogen and 1 of oxygen. Thus 2 specific gravities of nitrogen equals 1952 and 1 of oxygen 1102.6, both together equal $1952 + 1102.6 = 3054.6 \div 2$, the equivalent volume of the compound, = 1527.3, the specific gravity of the compound gas. Hence, in this way all the specific gravities of the compound gases may be actually determined from the specific gravities of the elementary gases entering into combination. This being the case the question now arises: What causes this connection between the specific gravities of gases?

It is a well known fact that substances unite chemically in certain proportions by weight, to produce compound bodies. Thus oxygen and hydrogen unite in the proportion of 1 of the latter to 8 of the former to produce the compound water, and will unite in no other proportion to produce water. Hence, there must be a physical law which governs substances in their chemical union.

In the combination of gases by volume, there is a physical law also which makes them unite in the same proportion by volume to produce the same compounds, also as regards the specific gravity of the natural and artificial gases, there is a physical law which predominates over matter, and governs and controls the weight of gases in comparison to their bulk.

In order to determine the comparative forces in matter, we must examine it while in the same molecular condition, and as there is but one condition, that matter can be said to be in the same molecular state, and this a gaseous state; therefore, matter must be examined in this state in order to ascertain its molecular forces. Consequently we will examine those substances which are in or may be brought into a gaseous state, while in that state, and by that means,

doubtless, we shall be enabled to arrive at some standpoint which will help us in the solution of the question before us.

Specific gravity is the comparison of the real gravity of a gas with its volume or bulk. Gravity is the weight of a substance without regard to bulk.

Now if we are able to compare the weight of one gallon or measure of one gas, with the weight of one gallon or measure of all others, we have a standpoint from which we may be enabled to ascertain the comparative forces which exist in the molecules of each gas.

To determine this we must first ascertain what gives weight to a substance, and secondly, what gives expansibility. We have already seen that the positive atoms at the surface of the earth have no weight or gravity, therefore their presence in a substance at such surface of the earth (where all matter is weighed), will neither increase nor diminish the weight of any substance at that point, but that it is the negative atoms which gives weight, exclusively to matter. Hence, in determining the specific gravity of gases, we are in reality determining the comparative amount of negative material in each gas which is contained in a volume, or the same measure; that is, should one gallon of hydrogen gas weigh in comparison to some other gas taken as a standard, as air, fifteen times less than one gallon of air then this fifteen times less than air would represent its comparative weight by volume or measure with air. And as the negative atoms in a substance cause exclusive weight to the same, therefore the negative material of hydrogen gas is fifteen times less by measure than the negative material of the same measure of air. In like manner the negative material of any substance in a gaseous state may be ascertained and compared with other gases. Hence, the specific gravity of all gases, if correctly obtained, will constitute a complete comparison of the amount of

negative material in each gas, with all others in the same measure.

We have now determined the negative material and its comparative amount in the gases in the same volume; it now remains for us to determine the positive material, and its comparative amount in each gas in the same volume, and our work is completed, for we shall then ascertain the comparative forces which exist in the molecular constitution of each gas; because in determining the comparative amount of negative and positive material, we in fact determine the forces which exist in that materiality, for the forces imparted to the atoms of matter are unchangeable and omnipresent with matter.

The positive atoms give no weight to a substance, nor do they lessen the gravity of the negative atoms only as they increase the expansibility of the molecules of matter, which only affects the amount of negative material in the same measure. In reality the positive atoms do not affect the weight of any gas only as relates to measure or volume, for a gas which is expanded twice its original measure will weigh just as much, taking the whole gas expanded the two measures; the two measures in its expanded state will weigh just as much as the one measure in its original state, but as regards volume, this gas in its expanded state will weigh just one-half as much as it did before expanded or rarified.

We have heretofore shown how the positive matter causes the expansion of gases, and also that it is the exclusive material which produces such expansion, and is the cause of the repulsive capacity of their molecules, and greater the amount of positive material which incloses the negative atoms of each molecule, more repulsive the molecules will become; hence more rarified or expansive the gas, and greater the distance intervening their molecules, the less will be the specific gravity of the gas; while on the other hand, closer the molecules are to each other, greater

will be the specific gravity of the gas. Consequently, as the positive atoms are concerned exclusively in the expansion of the gases, and their rarity depending upon positive matter alone, greater their rarity, greater the amount of positive material which surrounds the negative atoms, and vice versa. Therefore the specific gravity of a gas not only compares the negative materiality of the same, but the positive, also, with other gases, one giving weight and the other expansibility to the gas, and in thus determining the comparative amount of positive and negative material in a gas of the same measure with other gases, we at the same time determine the comparative forces which exist in that comparative amount of positive and negative material in each gas.

Hence, as the specific gravity of the gases represent the comparative forces which exist in the molecules of gas, therefore, the specific gravity of the gases determine their atomical weights as follows, according to the molecular forces of matter thus: taking hydrogen as a standard, its specific gravity being 68.8 and dividing it by itself— $68.8 \div 68.8 = 1$, the atomical weight of hydrogen, and by dividing the specific gravity of each gas respectively by the same number, 68.8, we produce the atomical measure or weight of each gas according to its specific gravity as shown in the following table:

Substances	Specific Gravity	Specific Gravity ÷ by 68.8
Chlorine	2454.0	35.60
Fluorine	1296.0	18.96
Oxygen	1102.6	16.00
Hydrogen	68.8	1.00
Nitrogen	976.0	14.18
Carbon	825.6	12.00
Sulphur	6648.0	48.30
Phosphorus	4327.0	62.88
Iodine	8701.0	126.48
Bromine	5390.0	78.39
Arsenic	10362.0	150.60
Mercury	6969.0	101.32

Having divided the specific gravity of each gas by the same number, we reduce them in the same proportion; therefore the quotients not only represent their atomical measure, according to their molecular constitution, but also continues to represent their specific gravities of lesser volume.

Substances in the table unite according to their specific gravities, thus: Oxygen on uniting with hydrogen to form water takes 1 specific gravity of oxygen, 16, and 2 specific gravities of hydrogen 2, making $H_2O=18$. Oxygen unites with hydrogen in another proportion, containing 1 specific gravity of each as $HO=1+16=17$.

The reader will observe that the number of specific gravities of each gas is the same as the gases unite by volume, or some multiple thereof thus: water contains 2 volumes of hydrogen and 1 of oxygen, and HO contains 1 volume of each kind, which is the same as the numbers of specific gravities entering into combination. Nitrous oxide contains 2 volumes of nitrogen to 1 of oxygen. It also contains two specific gravities of nitrogen to 1 of oxygen, thus: 2 specific gravities of nitrogen $=28$ and 1 of oxygen $=16$, which makes $28+16=44$. Sulphuric acid is composed of 2 volumes of sulphur to 9 volumes of oxygen. It also contains 2 specific gravities of sulphur to 9 of oxygen; 2 specific gravities of sulphur are 96, and 9 specific gravities of oxygen are 144, which on reduction is equivalent to sulphur $16+$ oxygen 24, which represents SO_3 .

In like manner all substances in the table unite according to their specific gravities when converted into a gas; the number of volumes which one gas unites with another is nothing more or less than the number of specific gravities which each gas takes on entering into combination with another gas. Hence, all gases unite according to their specific gravities, they either take 1, 2, 3, 4, 5 and so on, as the case may be, specific gravities in their chemical union with each other, and the number of volumes entering into

combination represents the multiples 1, 2, 3, 4, etc., of their specific gravities. The specific gravity of the gases, multiplied by the number of volumes entering into combination, produces the atomical weight of each gas thus entering into union with each other.

The facts before us therefore lead to the following conclusions :

1st—That gases chemically unite according to their specific gravities.

2nd—That the specific gravities of the gases determine their comparative molecular constitutional forces and gases in their chemical union are controlled by these forces.

3rd—That inasmuch as the natural and artificial gases follow the same laws, especially in their chemical union, therefore the same forces which produce artificial gases must produce and hold the natural gases in that state.

4th—That the specific gravities of all substances determined while in a gaseous state, represent the comparative molecular constitutional forces of such substances.

Gases not only unite according to their specific gravities chemically, but their diffusive capacity also depends on their specific gravities, for it has been determined that the law of the diffusion of gases is inversely proportional to the square root of their specific gravities. This law grows out of the attractive and repulsive forces of the atoms of matter operating in a molecule. (See Gases Chemically Considered.) (Also the Diffusion of Gases.)

CHAPTER IV.

Natural Elementary Gases Chemically Considered.



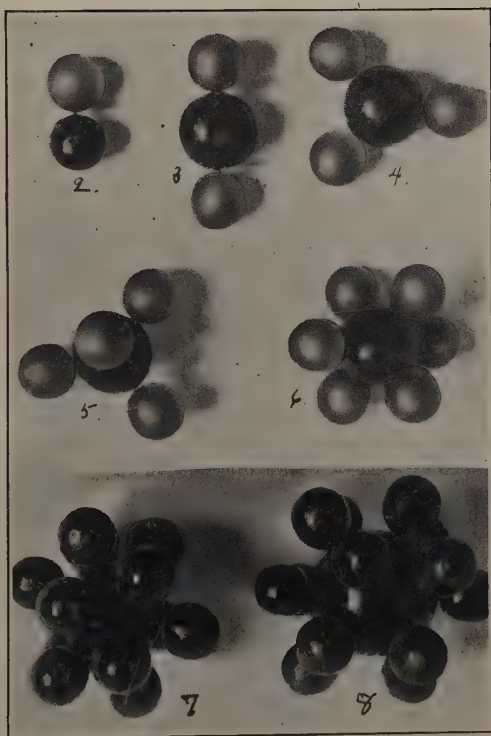
WE have seen that gases are composed of molecules, the negatives of which take many positive atoms on account of their affinity for the same; the negative atoms being spherical or spheroidal, and the positive atoms being attracted by them will be distributed over the surfaces of the negatives at equal distances from each other, through the mutual repulsion of such positive atoms over each other, therefore the molecules will be in a spherical or spheroidal form also. The negative atoms will take of the positive atoms to the number which will best satisfy their affinity for them, depending on the amount of matter contained in each respectively; a negative which is twice as large as another will take twice the amount of positive matter to satisfy its affinity to that of the other, providing there is space on the surface of such negative to contain such positive matter; if not, then such negative cannot take of positive matter according to affinity, but will according to space; hence we shall show that the difference in some of the properties of the natural gases is owing to this condition.

The next illustration represents the five natural gaseous molecules in the order of their comparative sizes: Chlorine, Fluorine, Oxygen, Hydrogen and Nitrogen, commencing with the smallest.

These figures represent a negative of a molecule of each gas with their surfaces surrounded with positive

atoms. We will thus compare the molecules with each other and determine their relative forces, etc., this being the simplest method to represent them on paper so that their relative forces can be more easily compared and determined.

Each molecule in the diagram represents a separate gas, hence all the molecules in any one gas will be precisely alike in their elementary condition, consequently possess similar forces. Therefore the molecules of chlorine will have the same size negative atoms as shown in the figure, and likewise so of other gases, each gas having a negative in each molecule peculiar to itself. Hence, in order to find a molecule which will represent a certain gas, we must study the history of that gas. Now we represent chlorine by the molecule No. 3, because the forces of such molecules will produce such a gas, and such gas can be traced to molecule No. 3, and can be shown on the consideration that its molecules contain the smallest negatives of the five gases above named and therefore take the least number of positive atoms to each negative than any of the others, consequently will take but few positive atoms to satisfy the affinity of the negatives. And as there is always more surface to a smaller than to a larger body in proportion to its contents, therefore the smaller negatives will have less positive atoms to the same amount of surface than the larger negatives; hence the smaller molecules will be less repulsive to each other and occupy less space, because the positives of one molecule can approximate the negatives of others through the space intervening the positive atoms connected with such negatives, and the attractive properties of the negative of one molecule for the positives of the others, although being less than the repulsive forces of the positives of one molecule over those of the others, yet the attractive properties of the molecules for each other are not reduced or weakened to the extent as would be the case if the molecules contained less space to the same amount of



positive atoms, as can be readily comprehended by observing the above figures and bearing in mind that the laws of attraction and repulsion are inversely proportional to the square of the distance intervening the source of attraction or repulsion.

The negatives of the above molecules are represented with sizes corresponding with the physical forces of the molecules of the gases which they are intended to represent, excepting the last, nitrogen, which is an exception as will be shown—greater the forces operating in the atoms of matter, larger the atoms must be to represent such forces, and vice versa. Hence, generally the specific gravity of a gas will depend on the size of the negative atoms in the gaseous molecule, to which there is at least one exception; a negative can be so large in comparison to the positive atoms, that its surface is so small in proportion to its contents that the surface cannot contain the number of positive atoms which the affinity of the negative actually calls for. This I have all reason to believe is the case with the negatives of nitrogen gas from the history of that gas. The determination of the sizes of the negatives of the different natural gases must be gleaned from their history. And judging from their history the molecules of such gases are represented as above.

The negatives of chlorine being the smallest takes the least number of positive atoms with the greatest space between its positive atoms, therefore the heaviest gas, its specific gravity being 2454. The negatives of fluorine being larger takes more positive atoms, and less will be the space between such positive atoms in their molecules, hence lighter will be the gas, its specific gravity being 1296. The negatives of oxygen being still greater, likewise the specific gravity of the gas will be still less, it being 1102.6. The negatives of hydrogen being larger still, therefore still less will be its specific gravity, it being only 68.8.

We find on the equatorial ring of the negatives of the

molecules of chlorine, fluorine and oxygen yet ample space for more positive atoms, but when we come to that of hydrogen we find the ring nearly covered. We also find the space between the positive atoms of each molecule diminishing as we increase the size of the negatives. We will suppose that the four molecules Cl, Fl, O and H have taken of the positive atoms according to their affinity for them, but when we come to nitrogen we find the surfaces of the negatives insufficient to contain the number of positive atoms called for by the size and the attraction of such negatives for the positive atoms, whereas the case would be otherwise if sufficient room could be had to contain them. Thus the negative of the molecule of nitrogen in the figure is represented to contain twice the amount of matter as that of hydrogen, and ought to contain twice the amount or number of positive atoms to satisfy its affinity for them to that of hydrogen, yet its equatorial surface would contain say only 12 positive atoms, while that of hydrogen would contain only 9, only 3 more than hydrogen, whereas it should contain 18. Hence nitrogen gas will be the heavier gas, because it does not contain the amount of expansive material as hydrogen does in proportion to the size of the negative atoms in each molecule, the specific gravity of nitrogen being 976. The positive atoms, as has been shown, produce the expansion of the gases, and the negative material the weight of the same. The molecules of nitrogen therefore are an exception to the rule, that as you increase the size of the negatives in molecules you decrease the specific gravity of the gas. The rule only applies in those cases where the surface of the negative atoms are sufficient to contain the number of positive atoms called for by the attraction of the negatives for the positives in their natural primitive state.

The comparison of the surfaces of bodies with their contents may be illustrated as follows: Should we take one block of wood containing 1 cubic foot and another contain-

ing 8 cubic feet, their contents would be as 1 to 8, while their surface would be as 5 to 20, hence the larger block contains less surface in proportion to its contents, than the smaller one, as $\frac{2^0}{8}$ to $\frac{5}{1}=2\frac{1}{2}$ to 5, just twice less surface in proportion to its contents than the smaller one in proportion to its contents.

The following considerations show that the specific gravity of the gases are the least where the surface of the negatives in a molecule is just sufficient to contain the number of positive atoms which such negatives have an affinity for, and the specific gravity increases as you recede from this point or go beyond it.

Gases whose molecules approximate each other in size resemble each other in properties; thus chlorine is a yellowish-green gas of a peculiar odor. Fluorine is a gas of yellowish-brown color and of a strong odor similar to that of chlorine. In many respects chlorine is similar to oxygen. It combines with almost all of the elements and with many compounds. This combination is often attended with light and heat, and therefore supports combustion. The metal antimony, for example, will burn in chlorine gas even without kindling. Of the five natural gases, chlorine and fluorine are the only ones that have color, which is owing to the fact that they are in a denser state than the others.

Oxygen, hydrogen and nitrogen, their molecules superficially being in a higher positive repulsive condition, therefore those gases are in a more rarified condition, hence the light will pass between their molecules and not be reflected to the eye. Thus water in that more condensed state has a peculiar luster, yet when converted into steam, being then in a highly positive and rarified condition, its particles cannot be seen, the light not being reflected to the eye and therefore is exclusively colorless.

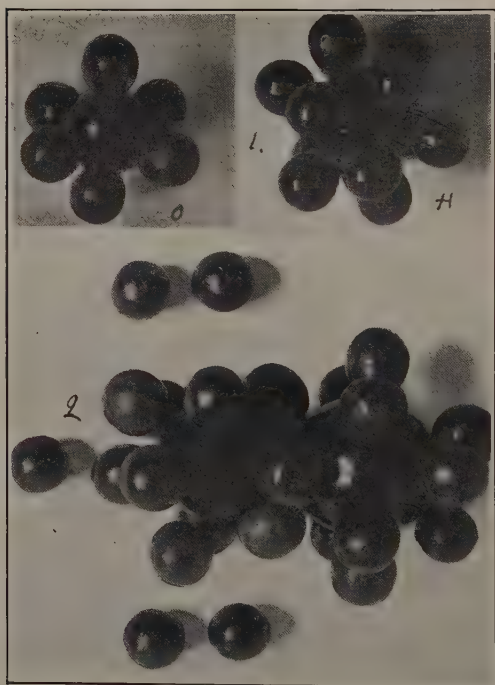
Oxygen is a transparent, colorless gas, a little heavier than the atmosphere. It is by far the most abundant substance in nature; like chlorine it unites with nearly all of

the elements and with many of the compounds and is the main supporter of combustion. Chlorine, fluorine and oxygen are supporters of combustion. I include fluorine as among the supporters of combustion, because of its analogy with chlorine and oxygen, and from the fact that it attacks nearly all of the metals. Hydrogen and nitrogen generally are non-supporters of combustion; in this respect they are similar, but in many others they are not. Hydrogen is an active gas, while nitrogen is a sluggard among the elements. Nitrogen being composed of molecules of the largest sized negatives of any of the natural gases, therefore its inactivity may be traced to that cause; the negatives of the molecules of that gas, as we have seen in the above diagram, does not take of the positive atoms according to their affinity for them on account of space, the effect of which will be explained in a further place of this treatise. Hydrogen and nitrogen, among the natural gases, unite with the least number of elements.

SECTION I.

COMPOUND BODIES—HOW FORMED.

Heretofore we have only treated of simple substances and the molecules of which they are composed. This section will be devoted to the formation of compound bodies from the molecules of simple substances. It is easy to comprehend how the molecules of the metals, the negatives of which are so nearly in size that they take only one or two positive atoms, unite with each other forming alloys, as for example brass, which is an alloy of copper and zinc. The negatives of all substances attract the positive atoms, therefore two kinds of negatives may become united by the intervention of positive atoms as easily as the negatives of the same element, even should there be quite a difference in their sizes which may be easily comprehended.



In like manner many sizes of the negative atoms of different solids may be united to form alloys. This may be termed a simple cohesive union of the different elementary negatives with the positive atoms. But when we come to chemical union of the molecules it becomes more complex, notwithstanding it is the absolute result of the union of the negative with the positive atoms.

Chemical union may be explained in the following manner. We will commence with the natural gases and show how they unite to form compounds, and then we will illustrate the union of the gases with the solids.

In order to illustrate the union of the molecules of the gases we will take for example the molecules of oxygen and hydrogen, thus: In Figure No. 1 of the illustrated page the two molecules, oxygen and hydrogen, are placed in close proximity to each other. The hydrogen molecule is the stronger molecule, containing the greater number of positive atoms, therefore has a stronger repulsive power or force than that of oxygen. That being the case the hydrogen molecule will magnetize the smaller one, that of oxygen, and allow the negative of the molecule of oxygen to come in contact with the positive atoms of the hydrogen molecule, and part of the positive atoms of the molecule of oxygen will be repelled off by the repulsion of the positives of the molecule of hydrogen, producing a great degree of heat which accompanies the chemical union of the two gases. This may be seen in the figure containing the molecules of oxygen and hydrogen chemically combined, with the liberated positive atoms at the side of the molecules.

Figure No. 2 shows the two molecules united by the negative of oxygen attached to the positives of hydrogen. This union is produced in the following manner. The positive atoms which are attached to and surround the negative, being susceptible of mobility around the negative, therefore they will be moved by foreign influences, such as that of another molecule. Hence, if we take two molecules

of two dissimilar gases, as oxygen and hydrogen, one having a greater repulsive force than the other as in this case, the superior force will control the smaller, consequently the repulsive forces of the positive atoms of the molecule of hydrogen will drive or repel the positive atoms of the smaller molecule, oxygen, towards the more distant part of the negative thereof, while the negative of such smaller molecule thus presents a surface to be acted upon by the attraction of the positives of the larger molecule, hydrogen, consequently the smaller molecule, oxygen, will be attached to the larger, hydrogen, and united by the negatives of the smaller molecule, oxygen, coming in contact with the positives of the larger, hydrogen.

The reader will observe that although there is a repulsive force exerted by the negative of the smaller molecule over that of the larger, yet the molecules will unite, because when the positives of the smaller molecule are thus driven or forced back from that side of the negative opposite the larger molecule, the attraction of the positive atoms of the larger molecule for the negative of the smaller will be superior to the repulsive forces of the two negatives over each other: First, because the attractive forces of matter are stronger than the repulsive, and Second, because the forces of attraction and repulsion are in proportion inversely to the square of the distance intervening the source of attraction or repulsion. The positives of the greater molecule being closer to the negative of the smaller than the negatives to each other, hence the attractive forces on this ground will predominate. These two forces however are so nearly equal while the molecules are in their natural state, that the union of the molecules is facilitated by forcing one molecule against the other. This may be done by various means.

The positive atoms above and below the compound molecule in the figure will be set free from the smaller molecule, because the affinity of the negative of the smaller mol-

ecule for the positive atoms is partially satisfied by coming in contact with two positive atoms belonging to the larger molecule, therefore its affinity is satisfied without them, so long as the two molecules are thus united.

It will be seen in the compound molecule in the figure, that the molecule of oxygen has become a perfect magnet; one side which is in contact with the molecule of hydrogen is negative, while the other is positive, containing positive atoms, the molecule of hydrogen being unchanged. Hence, we may say that the molecule of hydrogen magnetizes the molecule of oxygen and by that means produces chemical union.

We find in the union of oxygen with hydrogen that there is not only positive atoms set free, producing a great degree of heat as shown above, (which is nothing more nor less than combustion, which will be explained under the head of Combustion) the amount of heat thus produced depending on the amount and manner of such liberation, for motion must be given to the positive atoms in order to produce heat or light as heretofore shown, but aside from this there is also produced a condensation of the gases, the compound molecules occupying less space than their component parts in their elementary condition, which is also shown in the figure. This accounts for the condensation which always accompanies the union of two natural gases where there is an evolution of heat.

The union of the gases chemically in their natural state with each other, are precisely similar in all cases to the above case cited, oxygen with hydrogen, the larger molecule magnetizing the smaller, and the larger one becomes the base and may take into union one or more smaller molecules.

This shows that the hydrogen molecule can take only a certain number of the molecules of oxygen, because there is not sufficient space to contain them, and if the molecule of hydrogen is temporarily forced to contain or

take beyond its ability to retain, on account of space for the molecule of oxygen, the compound so formed will not be permanent, as in the case with the compound HO_2 , the hydrogen molecules taking beyond its ability to retain; therefore the surplus is thrown off when the force subsides which caused such union, like that of radiant heat, on account of the molecules of oxygen being brought into too close proximity to each other, and by their mutual repulsion, therefore, part of them are repelled off from the hydrogen molecule, and the temporary compound is converted into another one of a permanent nature, as water. To illustrate we will suppose that in this figure the molecule of hydrogen has taken all the molecules of oxygen it can retain on account of space, which is to the number say of 3. This we will term one proportion of oxygen, 8, and the compound thus formed HO water, containing one proportion of each element $8+1=9$. Now if the molecule of hydrogen is temporarily made to contain more molecules of oxygen, through some chemical operation, they will have to combine with the molecule of hydrogen at the space intervening the molecules of oxygen that have already combined with the molecule of hydrogen, as shown in the figure, and as there are just 3 spaces, therefore the molecule of hydrogen will temporarily take just 3 molecules more of oxygen, making 8, which is equal to 2 proportions of oxygen, producing a compound HO_2 , dentoxide of hydrogen, a compound of such temporary nature that its temperature has to be kept down below 58° , otherwise the oxygen will be evolved in abundance. That the increase of temperature produces an evolution of the oxygen from the compound, is sufficient proof that the position here taken is true. For the inevitable and general consequence of increasing the temperature of the compound, by adding more positive material to the same, and to the molecules of oxygen would be to make them more repulsive to each other, therefore increase their ability to repel each other from the compound,

or more properly from the molecules of hydrogen, and thus produce an evolution of some of the molecules of oxygen from the compound.

This also shows why the gases unite according to their specific gravities on entering into chemical union with each other. For as we have shown in the previous pages, that the specific gravity of a gas is determined by the weight of the negatives of the molecules compared with the space they occupy, the number of positive atoms determining the space occupied by the molecules in each gas; hence the molecules containing the greatest number of positive atoms will occupy the greatest space, excepting in the case of nitrogen as heretofore shown, therefore the molecule of hydrogen will occupy more space than that of oxygen, and as in the case above, we will suppose that it takes 8 molecules of oxygen to fill the space equal to that occupied by one molecule of hydrogen, consequently if it takes 8 molecules of oxygen to make 1 volume, while it only takes 1 molecule of hydrogen to make 1 volume, and therefore 1 molecule of oxygen is equal to $\frac{1}{8}$ volume, 2 molecules to $\frac{2}{8}$ volume and so on up to $\frac{8}{8}=1$ volume, and were it possible for oxygen to unite with hydrogen in the proportion of 1 molecule of each, it would be equivalent to 1 volume of oxygen to 8 of hydrogen, and 2 molecules of oxygen to 1 of hydrogen would be equivalent to 2 volumes of oxygen to 8 of hydrogen, and so on increasing the number of volumes of oxygen 1 for every molecule of oxygen added. Thus the combination of 4 molecules of oxygen with 1 of hydrogen is equivalent to 4 volumes of oxygen to 8 of hydrogen, which is, reduced, equivalent to 1 volume of oxygen to 2 volumes of hydrogen, forming water. This principle is applicable to all the chemical combinations. Thus should sulphur when converted into a gas, take 3 molecules to occupy the same space as that occupied by 1 molecule of oxygen, then in the chemical union of 1 molecule of each kind it would be equivalent to $\frac{1}{3}$ volume of sulphur to 1 volume of oxygen, which would be the same as 1 volume of sulphur to 3 of oxygen, SO_2 , therefore would contain 1 volume of sulphur to 6 volumes of oxygen.

The number of molecules of oxygen which enters into combination with hydrogen to form water is of no practical consequence, so far as the relation exists between the union of the elements by volume is concerned. If it takes only 2 molecules of oxygen to occupy the space of 1 of hydrogen, then we say water is composed of compound molecules consisting of an elementary molecule of each kind. In fact the molecules of all gases must stand in some definite proportion to each other, in relation to the space they occupy in their separate elementary state; they must occupy spaces which will be in this proportion to each other as: $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$ and so on as the case may be, and hence gases will unite in such proportion as will have definite connection with their specific gravities.

Molecules of the same forces cannot magnetize each other. Ordinarily molecules of the same size do not readily combine, yet gaseous molecules may and not much change their characteristics. Ordinarily, however, molecules of the same size cannot chemically unite, because they will not produce among themselves magnetical union, their forces being equal. In order to produce magnetical union, one molecule must be larger than the other, the larger one magnetizing the smaller, while the larger one remains in its superficial positive state exclusively, consequently the larger positive molecule will unite with the negative side of the smaller molecule, (see the molecule of oxygen united with that of hydrogen) whereas the molecules of the same size will exert similar effect over each other, and if one partially magnetizes the other by repelling the positive atoms from the side nearest to it, and presenting the surface of the negative of such molecule a corresponding effect will be produced to it likewise by the other molecule, therefore the two molecules will be just as repulsive to each other, because in their magnetical operations, the poles of the same kind are constantly presented to each other in such molecules, and each pole having the same force, hence they will not unite to

form compound molecules. This explains why oxygen ordinarily will not unite with flourine, because their molecules are so nearly of the same size; but flourine will unite with hydrogen because the difference in the sizes of the molecules of such gases is sufficient to produce magnetical union.

Two molecules of oxygen ordinarily will not unite with each other, because their forces are equal, and so of all of the elementary natural gases. No two molecules ordinarily can unite with each other of the same kind permanently, because their molecular forces are equal, hence the difference in the union of the molecules of substances with each other chemically, or by mere cohesive attraction; the former has reference to the forces which exist in the molecular constitution of matter, while the latter does not, the molecules uniting according to no particular molecular force.

Why the molecules of nitrogen are sluggish among the elements, is from the fact that the negatives of the molecules have not taken of the positive atoms according to their affinity. Why this should produce such results may be easily comprehended by comparing 2 molecules, say, oxygen and hydrogen.

Now the forces exerted by the larger molecule over the smaller, will depend upon the forces which exists in such larger molecule N. And as the negative of the molecule N has not taken of the positive atom according to its affinity, therefore such negative will have a tendency to attract to itself more positive atoms, consequently will have an attraction for the positives of the O molecule, and by that means counteract the repulsive forces of the positives of the molecule of nitrogen in forcing to the other side the positives of the O molecule; the attractive force of the negative of the molecule of nitrogen for the positive atoms of the O molecule acting in opposition to the repulsion exerted by the positive atoms of the nitrogen molecule over the positive atoms of the N molecule. Therefore the molecule of-

nitrogen is sluggish in producing magnetical union, being far behind the activity of other gases over concentrated matter—solids.

Owing to the repulsive capacity of the molecules of some of the gases over each other, especially those which approximate each other in size and forces, chemical union may not take place without foreign influences, such as the application of light, heat, or electricity, thus: oxygen and hydrogen may remain in contact an indefinite period of time without uniting to form a compound, yet on applying a lighted torch to them, or by passing an electrical spark through the mixture, they will combine with ignition. This is due to the assistance given to the magnetical influence of the larger molecule over the smaller one, and may be accounted for on the consideration that as light and heat and also electricity is positive matter in motion, and by that positive matter in motion a disturbance is produced in each molecule of the gases by the light, heat or electricity thus passing through them, this disturbance being agreeable to chemical union. One molecule repelled against another will assist chemical union, and as this positive matter which in motion produces heat, etc., being repulsive to the positive atoms of the molecules of the gases, would when repelled against the molecules thereof produce such a change as would facilitate magnetical union of the gases. This subject will be better understood when we come to explain the course of light and electricity.

Heretofore we have considered the union of all substances, as being caused by the magnetical operations of the larger molecule over the smaller while in a gaseous state. As regards the union of all the elements while in a gaseous state, this principle is true, yet there may be cases in chemical combination where necessity of such operations is not required. For instance, suppose in the case of the union of oxygen with hydrogen, that oxygen is in a nascent state should contain but few if any positive at-

oms, and while in that state should be brought into the presence of the molecules of hydrogen, they would unite immediately, because the molecules of oxygen could then be in a negative state and would unite directly with the positive atoms of hydrogen's molecules. Although this principle may not be applicable to the gases generally, that is the natural gases as oxygen and hydrogen, yet to many of the elements in nature, especially the solids in their chemical union with each other and the gases, this principle comes into play doubtless many times, for it is absolutely certain that should a molecule of any substance be deprived of its positive atoms, and be brought into the presence of a molecule containing positive atoms, it would unite with that molecule, and its affinity would be manifested in an extraordinary manner. Hence, this in many cases does away with the necessity of magnetism, as above explained, in the combination of the elements and shows why the gases unite more readily and act with greater intensity while in their nascent state.

Heat is often essential to chemical combination. This is most always the case when both substances are solid. Heat either converts them into a liquid or a gas, and by that means allows the molecules to diffuse among each other, whereby magnetical union can take place. Further heating often has the contrary effect. It causes substances already combined to separate from each other again. This is especially the case when one of them is a natural gas. Thus, if oxygen unites with a metal as gold or silver, the product is an oxide. Now if this oxide of silver or gold is heated, the oxygen passes off in a gaseous form and leaves the metal behind.

This is due to the fact that heat converts the oxygen into a gas long before the molecules of the metal approximate a gaseous form, and is thus separated from combination, the negatives of oxygen having a greater affinity for positive matter than those of the metals, on account of

their size, therefore they are the first to become a gas and to be set free from combination. If the negatives of the gas and those of the metal were the same size, the case would be different. All bodies, we have shown, will become a gas at sufficient degree of heat; those which become so by the least degree of heat will be the first to be separated from the combination and vice versa. Electricity has similar effect over compound substances.

The positive or negative condition of the molecules of substances, as relates to each other, is determined by the comparative amount of positive or negative material contained in such molecules at the time decomposition takes place in the compound, hence a molecule of one element, in comparison to that of another, may sometimes be positive and at other times negative.

Generally the positive or negative condition of the natural gases depends on the amount of positive material surrounding the negative atoms in the molecules, therefore in their natural state the gases will be arranged thus: those coming first in the list being positive to all coming after it, and those last in the list being negative to all coming before them—1st, hydrogen, 2nd, nitrogen, 3d, oxygen, 4th, fluorine, 5th, chlorine, which is inversely according to their specific gravities and hence according to their molecular constitution, those of the least specific gravities being the most repulsive and in a more positive condition. Although this would be their natural order, yet this may be entirely changed, especially as regards those molecules which approximate each other in physical forces. Thus chlorine may under certain circumstances become positive to oxygen, should the molecules thereof contain sufficient positive material to make it so in comparison to that of oxygen. The amount of positive material in a substance is subject to fluctuations by temperature and by chemical changes, which produce these results, therefore the molecules of different substances do not contain positive matter alike

under all circumstances, yet their negative materiality is never changed. (See Molecules of Elementary Substances.)

SECTION II.

COMBUSTION.

It has already been noticed that the chemical or magnetical union of substances is accompanied by an increase of temperature, and in cases where the union is powerful and active the effect may be so great that the bodies will become luminous. In such cases the chemical union is said to be accompanied by combustion.

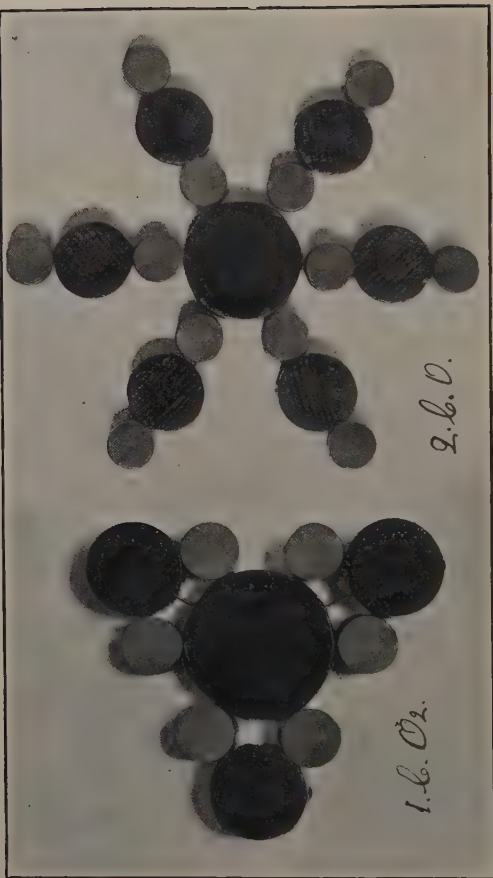
In common parlance, a body is said to burn when its elements unite with oxygen of the air, and produce new products. The accompanying phenomena in general are those on which popular attention becomes fixed, and for which the process is generally carried on and, therefore, to the world at large, combustion is of importance only as a source of light and heat. On the union of oxygen with hydrogen or sulphur, hydrogen and sulphur are termed the burning or combustible body and oxygen the supporter of combustion; but this language, though convenient for common use, is incorrect as a scientific expression, for we have seen in the former pages that in the union of the molecules of oxygen with those of hydrogen, the oxygen molecules are the ones which are acutely reduced in capacity, while the hydrogen molecules remain unchanged, and in all cases the larger molecule magnetizes the smaller in magnetical chemical union, producing heat, which accompanies combustion, and the smaller molecule is the one reduced of its positive atoms where there is a reduction, and this reduction of positive material to such molecules is the cause of combustion. Hence hydrogen is a supporter of combustion, and the same is true of nitrogen, especially when they unite with oxygen; oxygen being the one reduced, and

takes the place of sulphur and carbon, or stands in the same relation to hydrogen and nitrogen as sulphur and carbon do to oxygen. In combustion the molecules of sulphur and carbon being smaller than those of oxygen, they are the ones which are acutely reduced in positive materiality in their chemical union with oxygen. Therefore, hydrogen and nitrogen are supporters of combustion in some cases, yet in others they are not, which will be hereafter considered.

In the chemical union of carbon with oxygen in the combustion of a common candle, producing carbonic acid, the molecules of carbon are first reduced to a liquid, and probably to a gaseous state; the cohesiveness of the mass being thus destroyed at the point of ignition, and the molecules of carbon being thus liberated from the combustible are in such a state as to be subjected to the magnetical influence of the molecules of oxygen, producing chemical union.

In all cases the molecules of carbon must be brought into a liquid or gaseous state, before chemical union will take place, producing combustion. We will suppose that solid carbon contains molecules composed of one negative to two positive atoms, and in this chemical union the molecules of carbon are deprived of their positive atoms, or a portion thereof, producing the sensation of heat which accompanies this union, and also producing light, which is the product of certain molecular change of matter to be hereafter explained. (See Magnetical Union heretofore explained.)

The molecules of oxygen being thus supplied to the liberated molecules of carbon, the molecules of carbon on becoming attached to them will be disposed of in the following manner, depending upon the amount of oxygen entering into union with the carbon. The first figure on the next illustrated page shows the compound molecule of oxygen with carbon in the proportion of 1 of carbon to 2 of oxy-



gen, forming carbonic acid $=\text{CO}_2$. And the second figure, carbonic oxide CO.

In the first figure the oxygen molecule takes 3 molecules of carbon, and the carbon molecules are deprived of all of their positive atoms, as would be the case of such a chemical union, because their negatives' affinity for positive matter is satisfied by coming in contact with the positive atoms of the oxygen molecule, and each negative being in union with 2 positive atoms of such molecule of oxygen and therefore being in connection with the same number as they possessed before union, consequently their affinity is thus temporarily satisfied, and will no longer have attraction for the positive matter which they originally contained, that being liberated producing light and heat.

The second figure represents the compound molecule of carbonic oxide, the molecule of oxygen taking just twice the number of molecules of carbon as in the former case, and therefore they will be arranged as represented in this figure; instead of dropping in between the positives of the oxygen as in figure 1, the negatives will, through the repulsive capacity of the negative of the oxygen molecule over them, be kept at the extremity thereof as represented. This will be noticed at a glance, on examining the figure, as the natural result of the exercise of the forces of the atoms of matter over each other; and inasmuch as the negatives of carbon only come in contact with one positive atom each of the molecule of oxygen, the negatives of carbon will retain one of their positive atoms, consequently there is but one-half of the positive atoms of such carbon molecules set free, and twice the amount in the former case to that of the latter. Hence in both cases, if they are set free as readily in one as in the other and the same motion conferred thereon, then there will be twice as much heat and light produced in the former case, carbonic acid, to that of the latter, carbonic oxide, in proportion to the amount of carbon consumed.

This principle we find extends to the union of phosphorus with oxygen. Thus in phosphoric acid there is more heat produced than in phosphorus acid, the former containing less phosphorus. The same law holds good in the union of potassium with oxygen.

The reader will observe that in Figure 2 the compound molecule is in a proper condition to undergo another degree of oxidation, thus clearly showing why the molecules of carbonic oxide do again burn, producing more heat on a further degree of oxidation. The molecules of carbonic oxide will be observed to contain more carbon molecules than they can conveniently hold and retain, on account of the accumulation of too much negative material or atoms, therefore they are held very loosely and will be on the intervention of more oxygen molecules further distributed, leaving to each molecule of oxygen 3 negative atoms of carbon, and the other 3 will be divided among other molecules of oxygen; each molecule of oxygen taking 3 of carbon, producing CO_2 , carbonic acid.

There will be a slight discrepancy between the real molecules of carbonic acid and carbonic oxide and as here represented on paper, which may be seen on examining an artificial molecule. In the natural compound molecule of carbonic acid, the negatives of carbon are brought between 3 positive atoms belonging to the oxygen molecule, and are therefore held with stronger force and are thus deprived of their original positive atoms, producing light and heat.

These figures not only show how the light and heat is produced, but also show the condensation which takes place in the union of carbon with oxygen producing carbonic acid, and why the volume is the same in carbonic oxide, as the original constituents were in a gaseous state. This may be seen in the size and repulsive capacity of the compound molecules by comparing the same. The molecule of carbonic oxide is found to contain more positive atoms and in such position as to cause the molecule to be-

come more repulsive positively than the molecule of carbonic acid, hence the molecule of carbonic oxide will occupy more space than that of carbonic acid, and consequently lighter will be the gas. As regards the molecules of carbonic oxide occupying the same space as its original constituents in a gaseous state, the size of the compound molecule and its repulsive capacity as shown in the figure, would seem to warrant such a conclusion, or at least that the volume of such compound would approximate to that of such constituents.

This illustrates why it is that in some cases in chemical union the volume of the compound is the same, while in others it is the same as that of its original constituents in a gaseous state. Thus in sulphuric acid, SO_3 , the volume is reduced from 10, its constituents', to 6 in the compound, while in sulphurous acid, SO_2 , the constituents' is 7, and the compound stands at 6.

These investigations show that the amount of heat in the combination of carbon with oxygen in combustion depends upon the amount of oxygen consumed or entering into combination, not upon the combustible carbon, there being just as much positive matter set free in proportion to the number of molecules of oxygen entering into combination in carbonic oxide as that of carbonic acid, yet there are twice as many molecules of carbon consumed in the former to that of the latter, and if the liberation of positive matter is as rapid and as free in one case as that of the other, I see no reason why the amount of heat should not be the same as the amount of oxygen consumed or entering into combination.

We have seen that the mere liberation of positive matter without motion conferred thereon will not produce heat, (See Heat) therefore the light and heat in combustion will not only depend upon the amount of positive matter set free, but upon the motion given to such liberated positive matter. This motion is doubtless greater in more

rapid combustion, than where the process is less rapid in the same amount of oxygen consumed, for greater the amount of positive material set free instantaneously, more repulsion will be exerted on the outward portion of the same, repelling it away more rapidly from the source of liberation and thus giving more motion to such matter.

We have heretofore shown under the head of Specific Heat, that no absolute or definite connection exists between the specific heat of elementary substances, and the amount of latent positive atoms, yet it was there shown that in some cases there might be a striking relation between their specific heats and their chemical equivalents especially in some cases. Nor does their specific heats stand in absolute proportion to the amount of negative material contained in their molecules, yet in some cases there is doubtless a proportion. Hence the specific heat does not always stand in a definite proportion to their chemical equivalents, yet I have much reason to believe that the specific heat of a compound gas stands in some physical relation to the specific heat of another compound of the same constituents, although in different proportions of those constituents entering into combination. Thus the specific heat of carbonic acid, according to various experimenters, is greater than that of either oxygen or carbonic oxide.

This may be shown ought to be the case according to their molecular constitution, and may be explained in the following manner. Under the head of Specific Heat it was proven that in some cases the specific heats of elementary substances were in proportion to their negative materiality. Let us apply that principle to the above compound gases, carbonic acid and carbonic oxide. Thus if we take 1 proportion of oxygen, 8, as equal to 1 volume, then the comparative amount of negative material contained in the same volume of the compounds will be as follows: the negative material constituting the weight of a substance at the earth's surface, therefore the weight of the materials

entering into combination, will constitute their negative materiality, thus: calling 1 volume = 1 proportion of oxygen, 8, and 1 volume = 1 proportion of carbon, 6, then as it takes 2 volumes of oxygen and 1 volume of carbon to produce carbonic acid = $8 \times 2 + 6 = 22$, and that constituting 2 volumes of the compound; therefore, 1 volume is equal to $\frac{1}{2}$ of $22 = 11$, and as it takes 1 volume of oxygen, 8, and 1 volume of carbon, 6, to make or produce carbonic oxide = $8 + 6 = 14$, making 2 volumes of the compound; hence 1 volume would be $\frac{1}{2}$ of $14 = 7$, consequently the negative material of the gases will be as follows: oxygen, 8, carbonic acid, 11, and carbonic oxide, 7, showing that the specific heat of carbonic acid should be greater than that of oxygen, while that of carbonic oxide is a trifle less, which is nearly the same as verified by actual experiment.

As the specific heat of the gases is variously estimated by different experimenters, therefore they are not satisfactorily determined experimentally, yet I believe all make the specific heat of carbonic acid considerably more than either that of oxygen or carbonic oxide, while some make that of oxygen and carbonic oxide the same; others make one a little less than the other.

As the specific heat of any element is the same, taken under like circumstances, therefore, should we call the specific heat of oxygen 8 and that of carbon in a gaseous state 6, then as in the compounds above should we take parts of the volumes of the constituents producing these specific heats, their sum would be the specific heat of the compound, and the compound would be clothed with specific heat in proportion to the amount of the specific heats of the elements entering into combination, hence 11 to 7 should be the numbers which would represent the specific heat of the compound of oxygen with carbon, while 8 and 6 may not represent the numbers corresponding to the specific heat of oxygen and carbon, because there is no absolute

connection between the negatives of all elementary substances and their specific heat.

To illustrate this point more fully in relation to the specific heat of substances, let us suppose that it were possible to deprive oxygen of its positive atoms which are contained in a volume of the gas, and then obtain its specific heat, what would be the result? In the first place the positive atoms thus taken away would have to be supplied before we reached the common point from which specific heat is determined, and then raise it to the point required, which is some given point, making its specific heat under such circumstances very much greater.

Should each molecule of oxygen contain 12 positive atoms at a certain temperature, say at 50° , and we wish to determine its specific heat between 50° and 250° , and it is found to be 808. Now, should oxygen be deprived of its positive material, and its specific heat then determined, it would be equivalent to the addition of 12 positive atoms to each negative atom, which was thus taken away, to the specific heat determined between 50° and 250° , for 12 positive atoms must be added to each negative in order to bring the molecules up to 50° of heat. And allowing 1000 degrees for each positive atom in a molecule, there being 12, would make 12,000 to bring the molecule back to 50° , and thus adding the specific heat of oxygen, $808 + 12,000 = 12,808$, the specific heat of oxygen under such circumstances. This shows that the specific heat of a substance depends upon the amount of the negative material, in comparison to that of the positive in a molecule, to a great extent; greater the negative, greater the specific heat, and vice versa. Thus oxygen when deprived of all positive matter, its specific heat is enormous; likewise carbonic acid's specific heat is greater than that of carbonic oxide, because its molecules contain more negative in proportion to their positive material than carbonic oxide's molecules do, hence it will have greater specific heat. (See Specific Heat.)

We introduce this to show the fallacy of the idea of endeavoring to determine the amount of material which under certain circumstances produces heat, (which are the positive atoms,) by ascertaining the specific heat of substances. For it has been supposed that as carbonic acid contains a greater specific heat than oxygen in proportion to 1195 to 808, that it ought to contain more material which is susceptible of producing heat under proper circumstances, yet such is not the case, and ought not to be as shown above on physical grounds.

It is the negative material of a substance which gives weight to the same at the earth's surface, and has the same gravity in the compound as it did in the elementary substances which make up such compound, hence if we know the specific gravity of the same volume of the constituents of a compound in their gaseous state, we can determine the specific gravity of a volume of the compound, thus: the specific gravity of oxygen is 1109, and carbon, when converted into a gas is 825.6, and as 1 volume of carbonic acid gas contains 1 volume of oxygen and $\frac{1}{2}$ volume of carbon gas, 412.8 , therefore the specific gravity of carbonic acid gas will be $1109 + 412.8 = 1521.8$. And as carbonic oxide contains in 1 volume of the compound $\frac{1}{2}$ volume of oxygen, 554.5, and $\frac{1}{2}$ volume of carbon gas, therefore the specific gravity of carbonic oxide will be $554.5 + 412.8 = 967.3$. Nitrous oxide contains in 1 volume $\frac{1}{2}$ volume of oxygen, 554.5, and $\frac{1}{2}$ volume of nitrogen, the specific gravity of nitrogen being 979, one-half will be 489.5, making the specific gravity of nitrous oxide $554.5 + 489.5 = 1044$, showing that in the reduction of positive material the gravity is not changed.

The reason why hydrogen and nitrogen will not support combustion with the solids, as carbon, in the same manner as oxygen does, may be attributed to the fact that their physical condition is such that their molecules take the negative and positive atoms of the carbon in consort,

or collectively, therefore leaving no positive atoms to raise the temperature of the combustible. The temperature must be kept up in order to loosen and separate the carbon molecules from the mass of the solid, otherwise they cannot unite with the elements to form compounds, and therefore when a lighted taper is plunged into a jar of hydrogen, should the molecules unite with the molecules of carbon which have been thus liberated from the combustible, and in a gaseous state, yet if the molecules of hydrogen take the positive and negative atoms of carbon conjointly, the flame would be immediately extinguished, because there would be no positive atoms left to further raise the temperature of the combustible, and thereby keep up the conversion of the carbon into a liquid and gaseous state, which is an absolute requisite in combustion. As the specific heat of these gases is much greater than that of oxygen, it would seem that such may be the case; the specific heat of oxygen being only 808, while nitrogen is 1048, and hydrogen is 1459. Why one gas has a greater specific heat than others, may be found explained under the head of specific heat, although gases are not there considered generally, yet the illustrations there made are applicable to gases.

SECTION III.

CRYSTALLIZATION.

In passing from the liquid to the solid state, the molecules of most bodies assume a crystalline arrangement. In this formation of solids there is a force exerted over the particles of matter, more than the mutual attraction of their molecules, which causes them to unite under favorable circumstances to form crystals of the most beautiful and symmetrical forms. The crystals thus produced are often too small to be separately seen, but even when this is the case, the crystalline structure is readily observed. The surface fracture of cast iron or zinc are familiar examples.

The leaves and flowers of the vegetable world are scarcely more varied in form than those of crystals. The latter may be called the flowers of the mineral world, and are as distinctly characterized in their peculiar beauty as the organic flowers that may chance to bloom in the air above them. Even in many cases where color fails, yet the eye of science sees peculiar features which may enable it to determine the nature of substances from their external crystalline form. As every flower has its own peculiar form of leaves and petals, which characterizes its kind, so every crystalline substance has its own form or set of forms, from which it never especially varies.

It is very evident that in crystallization there is a force exerted over the particles of matter, aside from their cohesive attraction, otherwise the particles of matter would not arrange themselves into a crystalline form. These forces are simply the attractive and repulsive forces of the atoms of matter, which cause the crystalline arrangement of the particles of matter on consolidation.

Not attempting to speculate on the different arrangement of crystalline substances, by endeavoring to illustrate how each one is separately produced by the operations of these forces over the atoms of matter, I shall therefore content myself by furnishing my readers with a few general illustrations of these forces operating in matter, contributing to such results.

To illustrate the operations of these forces over the molecules of matter, we will take a molecule whose negative has such an attraction for the positive atoms that it takes two positive atoms each, and then notice what would be the natural result of the combination of such molecules into a solid.

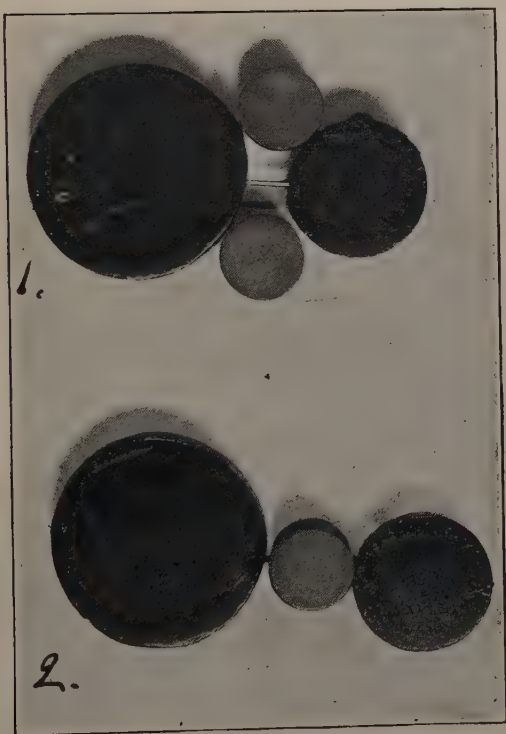
The next illustration shows the peculiar arrangement of such molecules into a solid, produced by the attractive and repulsive forces of the atoms of matter in such molecules.

In order to illustrate the expansion of water when con-

solidating or freezing, let Figure 1 represent a portion of a compound molecule of water containing 2 negatives and 2 positive atoms. Now, should 1 of the positive atoms be withdrawn, leaving but 1 positive atom, then the negatives would be further separated from each other as seen in Figure 2, caused by the repulsive forces of the negative atoms over each other. Therefore the 2 negatives will be repelled from each other as far as the size of the positive atom will permit, while in Figure 1 the negatives being connected with two positive atoms, and they having repulsive forces to each other, causing them to separate, the negative atoms will be as exhibited in the figure, closer to each other. This shows why at different temperatures certain substances on becoming solid expand, thus: water when its temperature approximates the freezing point, 32° , it expands, and occupies more space than at a higher temperature.

In the compound substances, many different crystals have their origin through the operations of these forces over different molecules having unlike constituents, or number of constituents.

By the operations of an attractive force alone no such results can be produced, nor by the repulsive force alone, but by the combination of these two operating at the same time over the atoms of matter in each molecule, on the consolidation of matter. We can see that such forces would produce peculiar results, as exhibited in the crystallization of different substances and the expansion of matter, which is the general accompaniment of such phenomena.



CHAPTER V.

The Sun's Light, Heat, Etc.



EAT, as we have heretofore noticed, is a peculiar molecular change of matter produced by the excess positive matter passing into a substance, causing expansion, liquification, and the sensation of warmth to the living organism. Light is the product of the excess positive matter in motion, coming in contact with the delicate mechanism of the eye, producing vision. Thus light, as well as heat, is the product of the excess positive matter in motion coming in contact with other matter: hence without motion, and that to this material, there will be neither light nor heat, consequently the intensity of light, as well as heat, will depend more or less upon this motion, connected with the amount of such positive matter under motion. Light does not depend so much on the amount of matter in motion, as the intensity of the motion conferred upon it, while heat depends, in degree, upon the amount of such matter in motion, and just sufficient motion to cause it to pass into substances, and as the slightest motion is sufficient, as we have seen under the head of Liquification, yet that slight motion is not sufficient to produce light, which accounts for the fact that heat is often produced without light, while light is seldom produced without heat.

To heat a substance the atoms must pass into that substance but if they do not, and are reflected to the eye

from that substance, then there may be light without appreciable heat to that substance.

Under the head of Heat we have shown how motion is imparted to the liberated positive matter from combustion and other sources which produce heat. This motion also produces light in those cases where the intensity is sufficient, in the manner we will now describe.

The atmosphere which surrounds the earth is composed of gases, principally oxygen and nitrogen, of about $\frac{1}{5}$ of the former to $\frac{4}{5}$ of the latter. These gases are composed of positive and negative atoms. These atoms are arranged into molecules, each molecule consisting of a negative atom and a certain number of positive atoms, arranged together in the manner heretofore described, (see Gases considered), to which the reader is referred. It may be there seen that the negatives of the molecules of oxygen take of the positive atoms in number sufficient to satisfy their affinity for the same, which will be in number, the contents of which approximates the nearest to the contents of such negative atoms; that is, should the negatives of the molecules of oxygen take 5 positive atoms, the negatives will have to be 5 times as large as 1 positive atom, and in as much as the repulsive forces are less than the attractive, therefore the negatives would take more positive material each. Hence we will consider the molecules of oxygen to contain equal amount of negative and positive material. The molecules of nitrogen have been heretofore considered to contain negatives, the surfaces of which are insufficient to contain the amount of positive material called for by their affinity for such positive matter, but stand in the proportion of negative 18 to positive 12 to each molecule; that is, a negative which should have taken 18 positive atoms to satisfy its affinity for positive matter, only takes 12. (See molecules of nitrogen.) Therefore the comparative amount of negative and positive material in the atmosphere will be in the same proportion as that in each molecule, which is negative

18 to positive 12, which is equivalent to 3 to 2, and as there is about $\frac{1}{5}$ oxygen to $\frac{4}{5}$ nitrogen in the atmosphere, therefore the negative and positive material will range thus: $\frac{1}{5}$ will contain equal quantities, and the remaining $\frac{4}{5}$ will contain 3 proportions of the negative to 2 of the positive material, which would make $\frac{1}{5}$ of $\frac{4}{5} = \frac{4}{25}$ more negative than positive material in the atmosphere, and according to the assumption set forth at the commencement of this treatise, that there is more positive than negative material in the earth, and that the earthy portions have taken their share of this excess and can take no more, according to the laws of attraction, (see earth's central heat,) hence should we add this excess to the $\frac{4}{25}$ balance in favor of the deficiency of the positive material in the atmosphere, which will be equal to say $\frac{8.0.0.5}{5.0.0.0.0}$, this will represent the amount of positive material unconnected with negative material, either in the earth or atmosphere.

The question now arises, what will become of this $\frac{8.0.0.5}{5.0.0.0.0}$ positive material unconnected with the negative, when intermingled with the atmosphere. It will rise above it, because the positive atoms at the surface of the earth have no gravity or weight, on account of the earth having taken this excess, (see central heat) consequently the weight or pressure of the air will cause them to rise above the atmosphere, the same as air is forced above the water by the greater gravity of water. But notwithstanding such positive matter has no gravity at the surface of the earth, yet above the atmosphere it has weight, a slight gravity, just sufficient to keep it surrounding the atmosphere, caused by the excess negative matter in the atmosphere, and the excess of the attraction over the repulsive forces of the atoms of matter, but ordinarily will not be attracted by earthy matter at the earth's surface.

It may be here noticed, that should any more positive material be added to the atmosphere, it would be repelled into space, and not be retained by the earth or atmosphere,

because should any more be added to the atmosphere the repulsive forces of this positive matter would be superior to the attraction of the atmosphere for it, consequently all above this excess of the positive over the negative material of the atmosphere will be repelled into space, in the same manner as that from the earth, (see radiant heat) therefore the atmosphere will retain by its attraction for positive matter only to the said excess. All above that amount will be repelled into space. This excess is supposed to balance the attractive and repulsive forces of the atmosphere, like that of the earth, for positive matter.

We now have above the atmospheric air, a great ethereal atmosphere, which doubtless extends many miles above it. One great feature of this atmosphere is, that according to the laws of repulsion and attraction operating in the atoms of matter, the positive atoms nearest to the atmospheric air, will have the greatest gravity, and then as you recede they will have less and less, until you reach the uppermost portion where they will scarcely have any gravity. This grows out of the repulsive forces of the positive atoms over each other, the most remote atoms from the atmospheric air, although being attracted equally by the matter of the atmospheric air with those that are nearest to it, (excepting the influence of space) yet, the positive matter in this ethereal atmosphere, intervening said remote atoms and said atmospheric air, will have a tendency to counteract the attraction of the atmospheric air by its repulsion to such remote atoms, the attraction and repulsive forces thus exerted acting in opposition.

This accumulation of positive matter in the great ethereal atmosphere of the earth, must be in a highly rarified condition, because of its slight gravity, and every atom therein being in a highly repulsive condition. Hence, although the matter of this ethereal atmosphere is only about $\frac{4}{5}$ of the amount of the positive material of the air, yet must occupy many times the space of that of the atmospheric air.

The atmospheric pressure of 15 pounds on every square inch at the earth's surface, doubtless has a tendency to force out the positive material which surrounds the negative atoms in the molecules at such surface of the earth, and by that means furnish positive material to increase the size of such ethereal atmosphere. That the molecules of the air at the surface of the earth contain less positive material than they otherwise would, were it not for this pressure, is evidenced by the fact that when this pressure is removed they absorb positive material from the surrounding matter, and thereby produce a certain degree of cold.

We have now shown how such an ethereal atmosphere can exist, agreeable to the forces imparted to the atoms of matter, according to the principles laid down at the commencement of this work.

We will now suppose matter to be universally alike in all worlds, with like forces imparted to it, according as is manifested in the earth as herein set forth; therefore all worlds will be constructed like our earth, the sun of our system not excepted, differing only in their size, principally, consequently in the extent of their physical forces. They will have, therefore, atmospheres similar to that of the earth differing only in size and capacity. We will suppose the earth's ethereal atmosphere to extend, say 10,000 miles beyond the atmospheric air, and all other planets, or suns, having ethereal atmospheres corresponding to the amount of matter contained in such planets or suns proper, in comparison with the earth, and as the sun is $1\frac{1}{2}$ million times larger than the earth, it would have an ethereal atmosphere $1\frac{1}{2}$ million times larger than that of the earth in materiality, extending say 100,000 miles beyond its atmospheric air. The moon being about 50 to 60 times smaller than the earth, would be so much less in atmospheric materiality, and may have an ethereal atmosphere extending say 20 miles beyond its atmospheric air.

With these figures before us, we will next notice what

would be the effect produced by these ethereal atmospheres of the sun, earth and moon over each other, connected with the rotation of such bodies as the earth, etc., on their axes.

Let us commence with the sun clothed with this ethereal atmosphere, extending 100,000 miles beyond its atmospheric air, and note its effect upon the earth, and the ethereal atmosphere of the same. The sun, like the earth, being composed of positive and negative materials, placed in the same position and standing in the same relation to each other, with the attractive and repulsive forces imparted to each atom similar to that of the earth, and there being more positive than negative material in the sun, it follows, that if the positive and negative materials of the sun were equally distant from the ethereal atmosphere of the earth, the attractive force of the sun's negative material would precisely balance the repulsive force of the sun's positive material over the positive material in the earth's ethereal atmosphere; the positive material of the sun being greater than the negative material, and the repulsive forces being less than the attractive, consequently the sun would neither attract nor repel the earth's ethereal atmosphere; its attractive and repulsive forces as concerns the ether of the earth would be precisely balanced. But in as much as the sun's ethereal atmosphere is composed of positive matter, and the earth's ethereal atmosphere composed of the same material, therefore repulsive to each other, and that of the sun extending 100,000 miles beyond the sun's atmospheric air, and therefore the greater portion thereof nearly 100,000 miles nearer to the earth, than the nearest negative matter of the sun, therefore the positive matter of the sun as a whole is nearer to the ether of the earth than the negative, consequently the repulsive forces of the positive material thereof will predominate over the attractive forces of the negative material as regards this ether. Hence the sun will exert a repulsive force over the earth's ethereal atmosphere, driving it towards the surface of the earth, giving motion to the same, producing light and heat.

The earth in rotating on its axis, continually presents a recruited ethereal ocean of atmosphere to be thus acted upon by the sun, and consequently during the day there will be a continual tide of this positive matter flowing towards the earth in the direction from the sun. This positive matter that has thus been sent down to the earth from the ether above the atmospheric air, will be radiated back by night (see radiant heat), or a part thereof, depending to a certain extent upon the amount thus repelled to the earth during the day, which is greater in the summer than in the winter. In the summer months the radiation is less than the positive matter thus sent to the earth, therefore the temperature of the earth will increase, while in the winter months the radiation is greater, consequently the earth loses in temperature.

The sun's ethereal effect in giving light and heat to the earth, will be exerted over all the terrestrial bodies, the moon and planets, etc., producing light and heat to them in the same manner as exerted over the earth, and the rays in striking a solid body will be reflected. Hence the waves of the moon's ether, sent by the sun against the solid portions of that body, will be reflected to the earth, etc.; that is, the waves will be sent against the solid portions and rebound, producing a stronger repulsive ethereal action over the ether of the earth from that direction upon which we may say the sun shines. This will do away with the theory of the existence of ether through all space, which I am led to believe does not exist, as its tendency would be to impede the progress of the heavenly bodies in their revolution around a common center, as the sun for instance in our system, unless the ether was moving in the same direction as such bodies with the same momentum.

If the sun through the repulsion exerted by its ethereal atmosphere, thus produces light and heat to the earth, the earth and other planets, through their repulsive ethereal atmospheres, must exert a corresponding influence over the

sun, but not to such an extent, giving light and heat to the same, consequently the sun may be inhabited by animals not inferior to those of the earth, and also clothed with vegetation for their support and subsistence.

Inasmuch as the ether of the earth's ethereal atmosphere is repelled to the earth by the sun by day, and is radiated by the earth by night, therefore this ether universally extends throughout the atmospheric air, and also may through all space, forming an extended ocean of ether from the sun and all the heavenly bodies to the surface of the earth. This ocean of ether, when set in motion, produces light and heat.

Although the sun is repulsive to the ether of the earth, yet the sun exerts an attractive force over the matter of the earth in general, and the earth over that of the sun, the attractive forces as a whole being greater than the repulsive, which constitutes the universal law of gravitation; the positive matter of the sun attracting the negative of the earth, and vice versa, and the positive of the sun repelling the positive of the earth, and the negative repelling the negative, but as there is a balance in favor of the attractive, therefore the attractive forces will predominate as regards the whole mass, the sun exerting a repulsive force over the earth's ethereal atmosphere, but not over the whole mass of the earth, hence the sun attracts the earth as a body, holding it in its orbit around it as a center.

How much, if any, the ethereal atmospheres of the planets Jupiter and Saturn may contribute to the production of their apparent belts, or the rings of Saturn, will be left to science to determine. It is evident, however, that if they have ethereal atmospheres in proportion to their materiality proper, they will be the largest of any belonging to the planets in our system.

SECTION II.

COLOR.

Color may be said to be a difference in the momentum of light, and it would seem from experiment that greater the momentum, greater the refrangibility of the same on passing through a prism. When we decompose a ray of light by means of a prism, and through the spectrum upon a screen, the luminous, the calorific, and the actinic radiations will each assume a different position. All will be refracted by passing through the prism, but in different degrees. The calorific radiations will be refracted least, and their maximum point will be found but slightly thrown out of the right line which the ray would have traversed had it not been intercepted by the prism. The heat diminishes with much regularity on each side of this line. The luminous radiations are subject to a greater degree of refraction, their point of maximum intensity being in the yellow ray. The light diminishes on each side of this point, producing orange and red below it, and green, blue and violet above it.

The radiations which produce chemical action are still more refrangible than light, and the maximum of chemical power is found at that point of the spectrum where light is feeble, and where but little heat can be detected. The rays of solar light, which are less refrangible than any of the visible colored rays of the spectrum, have all the properties of radiant heat coming from bodies of lower temperature than 800°F . Such heat is much less refrangible than red light, but if the temperature of the body be increased it will emit additional rays of greater refrangibility, equal to those of the least refrangible rays of light, the body then appears of the same color as the last refrangible rays of light, and is said to be red hot. If heated more it emits, in addition to the red, still more refrangible rays, as orange; then at higher temperatures yellow rays are added, and so

on, until when the body is white hot, it emits all the colors visible to us, and in some instances (of very intense heat,) even the invisible chemical rays, more refrangible than violet, are emitted, though in less quantity than in the solar rays. "Thus light appears," says Wells, "nothing more than visible heat, and heat invisible light—the constitution of the eye being such that it can perceive one and not the other, in the same way as the ear can appreciate vibrations of sound more rapid than sixteen per second, but not those which are less rapid."

The spectroscope on revealing to us the hidden mysteries of the universe, shows that every kind of elementary substance takes a peculiar and distinct part in the production of color, while in an incandescent state, which characterizes them, so that science has been able to determine the presence of various substances from the light they give out while in a burning or incandescent state.

Reasoning from analogy, the scientific mind has been led to the conclusion that the composition of the sun might be determined also, by the indication of the light from the spectroscope. As the light from the sun is pure white light, and the light from an incandescent solid is also pure white light, therefore it has been concluded that the light of the sun proceeds from a solid and not from a gas, as a gas gives out a different light. Now the idea that it proceeded from ether is from the assumption that the sun is in a burning, or incandescent state, and if it is not, as we have already sufficiently shown, then the determination of the sun's composition is impossible. The idea that any degree of combustion can possibly produce the light and heat of the sun is unworthy of a moment's notice, when we take into consideration the enormous distance the sun is from the earth.

It has been estimated by Prof. Young, that to produce the light and heat of the sun from combustion, it would take a layer of coal thirteen feet thick all over the sun's sur-

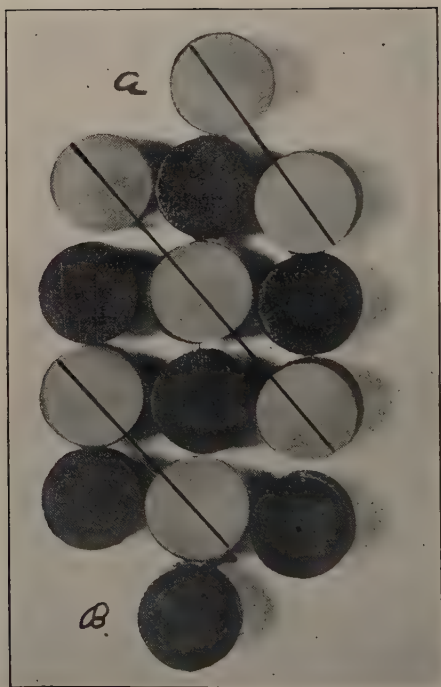
face, to be consumed every hour; that is, $\frac{2}{3}$ of a ton per hour for every square foot of surface. And at this rate, if the sun were composed of solid coal, it would entirely burn out in less than 6,000 years, hence at this date the sun would be extinct. It has also been found that the sun's heat has not diminished in intensity since the creation, or knowledge of man.

The different colors exhibited, or shown in the sun's spectrum, are due to the different momentums of light from the sun, caused principally by the irregularities in the depth of the sun's ethereal atmosphere; greater the depth of the same on that side opposite the earth, greater will be its repulsion to the ether of space and that of the earth, and less the depth, less will be its repulsion. And as the ethereal atmospheres are the product of the gaseous atmospheres, greater the depth of the gaseous, greater will be the depth of the ethereal just above them, hence it follows that if there are irregularities in the solid matter of the sun, like that of the earth, the ethereal atmosphere of the sun will be higher over the valleys than over the more elevated portions of its solid surface, consequently of less height over the mountains than over the valleys, and if of less height, less will be the repulsion to the earth from that point, and less the momentum of light proceeding therefrom, while the contrary is the case of that over the valleys, producing a greater momentum from that point.

The atmospheric tides also have a tendency to produce a depression or elevation in the ethereal atmosphere above them, causing different momentums of light to come from various points of the sun to the earth, producing different colored lights as exhibited by the spectroscope. The turbulence of the earth's atmosphere will also have an effect tending to modify the repulsion exerted by the sun over the earth. Thus should a wave of the earth's atmospheric ether be rising towards the sun, this would tend to counteract the repulsion of the sun, tending to force such ether

towards the earth, and the contrary would be the effect of such wave in its movements towards the earth; the two forces would then act in conjunction, increasing the movement of ether towards the earth, while in the former case they would act in opposition. Thus we can see why it is that the spectroscope shows different bands of light as coming from the sun, because of the different momentums of light, produced by the repulsion of the sun to the ether of space and that of the earth. The momentums connected with the amount of rays under motion, doubtless have much to do with the production of color. Thus red may be produced by a less momentum of a larger amount of matter; the yellow ray by a greater momentum of a less amount of matter; while the colors of greater refrangibility, by still greater momentums of but few rays of light, and hence the greatest intensity of light will be produced where the motion and amount of matter are just sufficient for the purposes of light. (See this further considered.)

The light of the sun produced from these ethereal sources could not be otherwise than pure white light, to which electric artificial light approximates so closely, and that the solid portion of the sun, with its attractive and repulsive forces existing in the atoms of matter, would have much to do in characterizing the light from that body the same as that from a solid body in an incandescent state. Hence, the spectroscope might determine the general constituency of the sun. The comets having a small nucleus with large atmospheres like our earth, yet much larger in proportion to its solid materiality, consequently when the comets come in closer proximity to any other heavenly body it would seem that there would be no probability of the comets being attracted into that body on account of such ethereal atmosphere of the comets and that of all the heavenly bodies, like the molecules of the gases which repel each other at certain distances on account of their being in an outward or superficial positive repulsive condition, and the heavenly bodies standing in such relation to each other.



CHAPTER VI.

Magnetism and Electricity.



MAGNETISM is a molecular change of matter which may be seen by examining the opposite illustration which is composed of an equal number of positive and negative atoms, with the positive atoms terminating at one end, and the negatives at the other, making a positive and negative pole, which will have an attraction for each other because the positive end containing more positive atoms than negative, such end will have an attraction for the other, which contains more negative than positive atoms, which may be seen in the figure, A representing the positive and B the negative pole of the magnet. Hence, the positive pole of one magnet will repel the positive of any other magnet and the negative pole the negative, and the positive of one will attract the negative of the other and vice versa.

We will suppose the metal, before magnetical induction, to be composed of an alternate positive and negative atom of nearly the same size, as the case may be. Now magnetism is a molecular change of matter from this state to that exhibited in the figure, a drawing or forcing the positives to an excess to one end, and the negatives to the other, producing a positive and negative pole, while the central portion remains unchanged; hence magnetism may be said to be superficial; that is, its forces reside at or near the surface of bodies.

To render a bar of steel magnetic, the positive end of the magnet is placed at the center of the bar of steel, and

repeatedly drawn over it towards one extremity. The positive pole thus produces a negative in the bar of steel, because the positive atoms of the positive pole will, in their attraction for the negatives of the steel bar, draw out towards the surface of such bar, and at that end towards which the magnet is drawn the negative atoms thereof, and in its repulsion to positive matter keep back the positive atoms of such bar, producing a negative pole at the end. And if the negative pole of the magnet be drawn from the center of such bar towards its other extremity, it will likewise produce an opposite, or positive pole in the steel bar, because the negative pole will draw out the positive atoms and repel the negative of those of the steel bar, and by this process a molecular change is produced in the bar of steel.

That magnetism is a molecular change of matter may be shown from the fact that substances, molecules of which are more easily changed, or susceptible of mobility, are more easily magnetized, yet do not retain their magnetism any length of time, because of their ability to fall back into their original state, which is more agreeable to the molecular constitution. While those substances as hardened steel, which are less susceptible of mobility of its molecules, are less easily magnetized, yet retain their magnetism to a considerable length of time. But as magnetism is foreign to the molecular constitution of a body, being produced by foreign forces, therefore such magnetical body will, if the poles are not kept united, gradually return to its original molecular construction. But if the poles are united by a piece of metal, connecting the polar attraction of the magnet, the atoms may be retained at the poles by the attraction of the positive atoms of one pole for the negatives of the other.

Heat weakens the power of a magnet, and white heat destroys it entirely, by making the molecules of the magnet more susceptible of change, (see Liquefaction) and allow-

ing its molecules to fall back into their original state, which is more agreeable to its molecular constitution.

The laws of magnetical attraction and repulsion are the same as that of gravitation; that is, these forces increase in the same proportion as the square of the distance from the center of attraction or repulsion diminishes inversely. Showing that inasmuch as the attraction of gravitation and the magnetical forces follow the same laws, that their forces stand in intimate relation to each other.

SECTION I.

ELECTRICITY.

Electricity is due to a peculiar molecular change of matter, therefore, like light, heat and magnetism, it is only the product of certain molecular changes in matter, which we will now attempt to explain. The solution of electrical attraction and repulsion may be found in the following and also other electrical phenomena may be thus explained.

All bodies we have shown are composed of positive and negative materiality, with attractive and repulsive forces imparted to the atoms thereof, as heretofore explained. Now let us suppose we have two bodies containing equal number of positive and negative atoms, and each atom of the same amount of materiality, and these atoms arranged into such bodies alternately a positive and negative atom. We will suppose each body to contain 100 of each kind. On placing these bodies together, we will find that according to their attractive and repulsive forces, they will have a very slight attraction for each other, because the attractive forces are stronger than the repulsive. This attraction of one body for another we call the attraction of gravitation when applied to the earth, which is the result of the balance of the attractive over the repulsive forces of the atoms of matter. The positive atoms attracting the negative, and vice versa, and the negative repelling the neg-

ative, and the positive the positive. Consequently the positive matter of one body will attract the negative of the other, and vice versa; and the matter of the same kind repelling the matter of the other of the same kind, but as the attractive forces are greater than the repulsive, therefore the bodies will possess an attractive force over each other, like that of the attraction of gravitation exerted by the earth over bodies at its surface, except it is proportionately less as the greater amount of matter of the earth exceeds the amount contained in such bodies.

Should each of these bodies be heated, and made to contain 200 positive atoms to said 100 negatives in each body the result will be the same as far as the attraction of the bodies are concerned; they will still attract each other, providing such positive matter is equally distributed through the mass thereof, each negative atom taking two positive atoms. Therefore, heated bodies do not necessarily become repulsive to each other, unless the positive matter of each, the greater amount thereof, exists at their surfaces, like the positive pole of a magnet, they will therefore be repulsive to each other. Hence, bodies become positively or negatively electrified through the predominance of positive or negative material at their surfaces, in the same manner as shown in the magnet.

This principle grows out of the universal law of attraction and repulsion, their forces being equal to the square of the distance intervening the source of attraction or repulsion inversely, which is beautifully illustrated in the molecular construction of each gaseous molecule. (See molecules of Gases). Here the positive atoms inclose each negative atom, forming a perfect repulsive molecule, and all such molecules are repulsive to each other in the first instance on close proximity, although containing equal amount of positive and negative material, because the positive matter of one molecule approximates the positive of the others, nearer than to the negative matter of such

molecules. This principle we may apply to all bodies. Should the positive materials of two substances as a whole be nearer to each other than the negative materials thereof, then such bodies will be in a positive repulsive condition to each other; but should they be so arranged that their negative materials in each body would be nearer each other than their positive materials, then such bodies, or substances, will be in a negative repulsive condition to each other; but while such positive repulsive bodies repel each other, and such negative repulsive ones repel each other, yet the positive bodies will attract the negative bodies, and vice versa.

Where there is a molecular change which produces such transformation of the atoms of matter in substances as above, temporarily or permanently, there will be an exhibition of an attractive or repulsive force of one body over the other, and in fact, the attractive and repulsive forces termed electrical, are precisely similar to magnetism, differing only, perhaps, in this: magnetical bodies have a positive and negative pole, while some electrical bodies may not have, being either superficially in a positive or negative condition. This electrical, or magnetical, state of bodies depending in degree upon the amount and location of that material, called positive and negative.

Why the drops of rain are generally positive when coming from the north, and negative when coming from the south, is from the fact that as the rain in the former case is colder than the stratum of air nearer the earth through which the drops have to pass on their descent, consequently they will become superficially heated, and temporarily thrown into a positive condition, while in the latter case, the rain being warmer than this stratum of air, the drops of rain will become superficially cooled on passing through the same, and thrown into a negative condition.

Bodies may thus be brought into this superficial positive or negative condition by instantly changing the positive or negative state of their surfaces, by thus adding

thereto, or abstracting therefrom, positive material. This may be done by heat, by friction or otherwise. It has been found that on mixing cold with hot water an electrical current is produced, the hot liquor being positive and the cold negative.

SECTION II.

HOW TRANSMITTED—ITS SOURCE, ETC.

Electricity may be said to be positive matter in motion, either in a body as from the thunder cloud, or along a conducting substance. That from the clouds always produces light and heat, and therefore corresponds in that respect to other motions of positive matter; but generally electricity differs from other motions of positive matter, in this, that its motion is conferred to it through the operations of both attractive and repulsive forces of the atoms of matter, while that of light and heat may be from the repulsive forces alone. Hence an electrical current on passing into the system will produce a different effect upon the same than heat, heat affecting only the surface first, while electricity is attracted and repelled in, charging the same throughout instantaneously. Therefore the difference between electricity, and light and heat, is in the fact that electricity is positive matter in motion, and such motion is a compound motion of the attractive and repulsive forces while that of light and heat may be but a simple motion produced by the repulsive forces alone.

We have shown that all material bodies are repulsive to light and heat. We will now show that positive matter, that in excess in nature, may be attracted by one body from another, and this matter thus passing from one body into another, through electrical or magnetical attraction, we call electricity.

We have seen how one body may have an electrical attraction for another; one must be in a superficial positive,

and the other in a superficial negative condition. Now on placing these bodies in close proximity to each other, the negative one will attract the positive matter of the positive body and as positive matter is constantly being radiated from them both, that from the positive body will be facilitated by the attraction of the negative body for it, consequently an instantaneous passage of a certain amount of positive material will be produced from the positive to the negative body, through this electrical attraction. This positive matter, with the motion thus conferred upon it, we term electricity.

Thus any body, while in a positive state, will give out electricity to another which is in a negative condition, providing the negative's attraction for positive matter thereof is sufficient to produce such results. Hence while the earth is in a negative condition, and the clouds are in a sufficient positive condition, there will be a passage of electricity from the clouds to the earth, and vice versa, especially when there is a material such as moisture intervening the clouds and the earth, which serves as a conductor.

Electricity though producing different effect upon the living organism through the motion it possesses, yet like other positive matter in motion it produces the effect of light and heat when passing through the ether which is ever present in the atmosphere, showing the connection thereof with other positive matter in motion. Motion conferred upon positive matter will always either produce light or heat generally, yet in some cases there is an exception, which will be noticed hereafter.

The difference in the effect of positive matter over a body by being attracted to it, and being repelled to it, may be easily traced. Thus, if a body has an attraction for certain positive matter, such matter on reaching the body will instantaneously pass over and into it, while if a body has no attraction for positive matter, and such positive matter is repelled against it, if it passes into the body at all it will

do so in opposition to the forces of such body. Therefore electricity enters a body to a certain extent as a welcome visitor, however much it may injure its organic state, while light and heat does not; electricity being attracted in by the body itself, and therefore entering agreeably to the forces thereof, while light and heat passing into bodies in opposition to their physical forces, excepting perhaps electricity in passing from a positive to a negative body, may come in contact with others having no attraction therefor, and caused to pass through or into them by the operations of the forces imparted thereto by the attraction of such negative body therefor. Thus electricity on coming from the clouds to the earth often passes through non-conductors, as glass, etc., which may intervene its passage by the force imparted to it by the earth's attraction.

By the attraction of the positive pole of a magnet for that of the negative, an electric current is induced in a magnet, the current passing from the positive to the negative pole outside of the magnet, and returning over the surface of the magnet from the negative to the positive pole, using the same one way as a conductor, and if the poles are connected with a good conducting material, this current is facilitated thereby. This current not passing over the magnet in a direct line from the poles, but around the magnet as indicated by the lines drawn through the rows of positive atoms as may be seen illustrated opposite page 99, in the figure representing the construction of a magnet, which shows that the electric current passes around the magnet in the form of a corkscrew helix, following the course of the rows of atoms which run around the magnet in that direction.

This is from the fact that bodies which are susceptible of becoming magnetical, and all good conductors of electricity, are thus atomically arranged by the operations of the attractive and repulsive forces of the atoms of mat-

ter, explicitly showing the connection of the physical forces operating over matter with its atomical construction.

On examining the construction of the central portion of the figure of the magnet, which exhibits its original metallic construction and illustrates the atomical construction of all good conductors, (that is, that portion through which the dark lines pass) we will observe that all bodies which are composed of an alternate positive and negative atom, their atoms will, if allowed to be constructed according to their atomical physical forces, be arranged as represented in the central portion of such figure, which is the most agreeable to such physical atomical forces contained in such bodies.

Hence, the course of all currents over conducting wires will run around such wires in the form of a corkscrew helix instead of passing in a direct line over the same, because the chain of the atoms of the same kind run around in that direction, and the transmission of the effect of electrical presence at one end of the conductor, if transmitted at all, must be through the connection of the chains of atoms of the same kind, and if those chains of atoms extend around the surface of conductors in the form of a corkscrew, the electrical effect or current will pass in that direction also.

This will be seen by referring to the figure at the commencement of this chapter. You will there observe that the negative atoms are united with the positive atoms according to the forces existing in the atoms of matter. Now, on applying more positive matter in motion at one end of a conducting agent as a wire, etc., in order that it may be transmitted over said conductor it must follow the course indicated by the lines drawn across that figure, as the lines of atoms show, which will form a perfect helix around the wire. Should we add one positive atom it would, if under motion, take the place of the first atom of the same kind, and through its repulsion would cause the first positive

atom of the conductor to take the place of the second, and the second of the third and so on through the whole wire over its surface, and thus an atomical change is produced over the wire, while the positive atom added to end A has only passed in the direction of B only to the distance of the space occupied by one positive atom of the conductor on the surface thereof.

As evidence of the direction of the electric current we have the following facts. The poles of the magnet may be made to revolve around a fixed electric current in a wire, and also a movable wire traversed by a current may be made to rotate around the pole of a magnet, which would not be the case if the electric current did not pass around their surfaces as above described.

HOW PRODUCED.

Electric currents may be produced by heat or chemical decomposition; by heat as in thermo-electricity, and by chemical decomposition as in the case of the Galvanic battery, and in this decomposition there is also heat produced.

We will next endeavor to show that the current produced in both cases is the result of the same physical forces operating in the atoms of matter. In the production of the thermo-electric current we take two metals of different conducting forces, or if the same metal is used throughout it must be so constructed that where the meeting of the ends of the metal takes place one end will have a greater conducting ability than the other.

To illustrate, let us take two metals as copper and platinum. On applying heat at the juncture of such metals an electric current will be produced every time the other ends are brought together, the current running invariably in the direction of the best conductor around to the other. On applying heat at the juncture as above, according to the principles heretofore explained, the ends of each metal thus joined will become positively electrified at first by add-

ing more positive material to their surfaces, but the best conductor of heat will be less positive than the other, because the heat thus applied will be conducted off towards the other end of the metal faster than can be accomplished by the lesser conducting metal towards its other end. Consequently as the lesser conducting metal becomes more positive by the superior amount of positive material on its surface thus accumulated, it will produce a negative pole in the better conducting metal, at the juncture thereof, by forcing away the positive and drawing out the negative atoms at that point, while at the opposite ends of such metals the better conducting metal will accumulate positive matter at its opposite end faster than can be accomplished by the other at its opposite end; therefore a positive pole will exist at the opposite end of such better conducting metal, and a negative in the other, and by the operations of these magnetical forces an electric current is produced over their surfaces.

In the same manner all electric currents are produced. Thus in Volta's battery the same principles are involved. There are two metals of different conducting forces, as copper and zinc; copper being twice the better conductor of the two of heat. These metals are immersed in sulphuric acid in the same vessel; that is, one end of each, and the others are connected with metallic conductors. With such a battery before us let us notice its operations. The sulphuric acid decomposes or burns the zinc producing heat, while the copper is but slightly affected thereby. Thus in this chemical action there is heat supplied to the metals as in thermo-electricity, producing the same results, excepting the electricity thus excited is of greater amount with more even flow of current, which may be partially attributed to the fact that the heat generated by the decomposition of the zinc metal being greater than that of the copper, operates to produce a positive pole in the zinc where it is required, and the application of the greater amount of heat

to that metal operates to facilitate the electric current by thus producing a higher state of magnetism in the metals than is generally produced in thermo-electricity, but in every other respect the operations are precisely similar to that of thermo-electricity.

That the current in both cases is the result of the same forces may be shown from the following facts: 1st—The electrical current is always in proportion to the amount of chemical action, or combustion of the metals, therefore in proportion to the heat produced, especially at the positive pole which is immersed in the acid. 2nd—The current always flows from the metal most acted upon to the other, which is the least decomposed, whether the metals used are of the same or different materials. 3d—The extremity of the metal most acted upon or burnt always becomes a positive pole, while the other becomes negative, whether the materials used are the same or different materials, and the metal the least affected or burnt, its extremity immersed in the liquid, always becomes a negative pole, while its opposite extremity becomes a positive pole.

If we take a metallic ring and heat it at one point only with a spirit lamp no electric effect ensues, but if the lamp is moved an electric current runs around in the direction the lamp has taken, because the liberated positive atoms from the lamp in their repulsion to the positive matter on the surface of the ring, would generate a current in that direction around the ring while the lamp is moving, in the direction the lamp has taken, the repulsion being greater in that direction, while if the lamp remains still, the repulsion exerted by the positive liberated atoms from the lamp will be the same in either direction, consequently the repulsion being the same in all directions, no current could be excited around the ring, the forces being equal in either direction around the same.

An electric current being positive matter in motion over the surfaces of conductors, we can easily comprehend the

result of obstructing or breaking a circuit, or current of the same, over such conducting surfaces, it being the same material in motion which produces light and heat in the manner heretofore explained. Therefore, so long as the current flows over the conductor unobstructed, freely and unbroken, no lighting or heating effect will be produced thereby, because the surface of the conductor is not increased in positive matter, and the motion of the positive matter over the conducting surface being in the direction of the conductor, that motion cannot disturb the ether in the atmosphere, consequently no light nor heat will be produced along the surface of the conductor. But if obstructed, or at certain points only partially supplied with conducting surface, it being insufficient to supply the current, an heating effect will be produced by the accumulation of such positive matter in motion, and if allowed to escape into the atmosphere it will set in motion the ether thereof, producing light. The same will be the result by breaking the current.

SECTION III.

THE DIRECTION OF ELECTRICAL AND MAGNETICAL CURRENTS FURTHER CONSIDERED.

We have already shown that the currents flow around the conductors in the form of a helix, instead of pursuing a direct course over their surfaces, on account of the atomical construction of the surfaces of such conductors, and the same is true of the currents flowing around magnets. Now by observing the construction of the magnet and that of the conductors, as represented in the figure in this chapter, it will be seen that the current must take either the right or left hand direction, as indicated by the rows of atoms in the figure, forming either a right or left hand helix. The question now arises, does it flow to the right or left, or in either direction as chance may dictate.

We know that the current always flows from the negative end of a conductor to the positive end, and that in flowing over such conductor it either turns to the right or to the left, and this is invariable over all conductors, for the experiments with the poles of a magnet and the movable conducting wire show that the electric current always flows in the same direction, because the poles in relation to the conducting movable wire always revolve in the same direction, which would not be the case if the current turned either to the right or left by chance over the surfaces of such bodies. Therefore, the currents must flow invariably in the same direction; they will then stand always in the same relation to each other. If this should be either to the right or left either course would produce the same effect, providing the currents over all bodies turned in the same direction; the currents would then stand in the same relation to the poles of such bodies.

To determine the course therefore pursued by the electric current around a conductor, or magnet, we must notice the course of the magnetical current of the earth, and if that turns to the right on its passage around the earth, all others will also, as the earth is the great magnet, in comparison to which all others sink into comparative insignificance, therefore all others must conform to this one, and as the direction of the current of the earth is, so will all others be also; as all bodies at the earth's surface are a part of the great magnet—the earth—they will be influenced thereby, and the direction of the currents around them on further magnetical induction will be controlled thereby. But before we attempt to explain the magnetism of the earth, let us notice the error into which many have fallen, in supposing electrical forces to differ from all other forces in nature, which is not the case. They are precisely in accordance to all other motive forces. It having been shown that all other forces exerted between two points act in the direction of a straight line connecting those points, and because the

magnetic needle turns to right angles to an electric current, it was supposed that the forces there exerted differed from other motive forces.

To explain this we will suppose we have a conducting wire over which passes an electric current, and we will suppose that all electric currents pass around conductors to the right, forming a right hand helix, commencing at the negative end and passing around the conductor or magnet in the form of a screw, and finally terminating at the positive pole, therefore the current may be said to have a general and special course or direction; its general direction is from the negative to the positive pole, while its special direction may be said to be its circuitous route around the conductor, or magnet, on its approximating the positive pole.

Now, should we place a magnetic needle over the wire, through which an electric current flows, and as this needle has also an electric current passing around it from the negative to the positive pole, this current will also have a general and special direction, its general direction is from the negative to the positive pole, while its special direction will be around it, this needle will cross the wire at right angles, because this will be agreeable to the compound forces existing in the wire and needle, or flowing over their surfaces. The needle, therefore, endeavors to assume a position at right angles to the general direction of the current in the wire, and should we stand facing the current in the wire, that is, should the current in the wire be approaching us, the south pole of the needle would be to the right, and the north pole to the left of us. The needle in taking a course across the wire brings the general direction of the current in the wire precisely in the same course with the special direction of the current in the needle, and the general direction of the current of the needle in precisely the same course of the special direction of that of the wire, which is agreeable to the laws of all matter in motion, the general direc-

tion of one current conforming to the special direction of the other, and vice versa.

You will find that it is that part of the special current of the wire which corresponds with the general direction of that of the needle which lies nearest to the needle, its course thus running with the general direction of that of the needle from the negative to the positive pole, while that part of the needle's special direction of its current nearest to the wire, runs in the direction of the general direction of the current in the wire.

Now, should the needle be placed under the wire the special direction of the current of the wire and needle nearest to each other, or nearest to the needle or wire, will be reversed because the current's special direction at a point directly above the wire over its surface, and that directly beneath it will run in contrary direction, and so of that of the needle, and as that part of the special direction of the currents which lies nearest to the needle and wire which necessarily controls according to the laws of attraction and repulsion, they being according to distance, therefore the needle will be reversed. (See cuts in your common Philosophy.)

It may be well to notice here a few facts experimentally determined, which may tend to embarrass this assumption that the current turns to the right, unless noticed here and explained, for it has been determined elsewhere that the current in flowing through a right hand helix magnetises a needle producing a south pole in the same at the extremity through which the current enters the helix, while in a left hand helix a north pole is produced at that extremity. Now my explanation of this is: in the former case the right hand helix, the current enters the wire and passes round it in a right hand direction, and at all places on the inside of the helix, the special and general direction of the current tends to excite in the needle an electric current flowing around the same in a right hand direction, as indicated by

the screw of the helix, producing a negative pole at the extremity of the helix the current enters, while on the other hand the result is different in the left hand helix, because the current always flowing to the right around a conductor, and in thus flowing to the right around the wire of the left hand helix, the special direction of the current will run in precisely an opposite direction to that in the former case, consequently would excite a current in the needle in the opposite direction, producing a positive pole, where in the former it would be a negative. (Cuts of helices examine and trace.)

SECTION IV.

MAGNETICAL AND ELECTRICAL CURRENTS OF THE EARTH.

We have said that the magnetical current of the earth runs around the earth in the form of a right hand helix. This may be demonstrated from the following facts, viz: 1st—The earth being a magnet there must be, in analogy with all other magnets, an electric current flowing from the negative north pole to the positive south pole, because all magnets have such currents. 2d—This magnetical current must flow to the westward from the north pole and screw around the surface of the earth in the form of a right hand helix, and finally terminate at the south pole, because the forces which produce or excite such current operate in that direction.

The earth's current is supposed to be produced by the heat of the sun in the following manner, thus: If we take a metallic ring and heat it with a spirit lamp an electric current will be produced in the direction the lamp has taken in the manner heretofore noticed. This current, however, does not flow around the ring in a direct line indicated by the movement of the lamp, but screws around the surface of the

ring in the form of a helix, caused by the construction of its particles. In like manner a current is supposed to be produced around the earth in the direction from east to west by the motion of the earth connected with the heat of the sun, and instead of the current flowing precisely in a westerly direction, inasmuch as such current must commence at the negative or north pole and finally terminate at the positive or south pole in order to produce an electrical circuit like all other magnetical currents, therefore, it will run around the earth in the form of a right hand helix from the north to the south pole. The tendency of the sun's heating rays is to produce an electrical current precisely to the westward with the equator, yet the tendency of the current to connect the poles of the earth, causes the current to flow in a south-westerly direction connecting the two poles thereof, and should you stand at the north magnetic pole facing the south, the current in thus flowing to the westward, would also be to the right of you, showing that the flow is to the right and goes around the earth in the form of a right hand helix. This current runs obliquely to the equator of the earth, forming an angle of about 18° , making the magnetic poles about 18° from the terrestrial poles.

The magnetic needle will stand at right angles to this current, with its positive end pointing towards the negative pole of the earth, and the negative pole towards the positive pole of the earth, because the special direction of the electric current of the needle nearest the earth's current will be in the same direction as such electric current of the earth. (See this subject treated above.)

The diurnal and annual variation of the magnetic needle may be attributed to the irregularities in the flow of this great magnetical current, thus: Supposing a stream of water should be flowing in a certain direction, and the central portion thereof should be by some cause caused to flow more rapidly than the more outward points, at a certain place. This would cause a fall of the stream at

the center and the outward portions, in order to fill up the vacancy, would tend to flow more in that direction, and by that means the general course of the stream at the outer portions will be temporarily changed towards the center. Thus the magnetical current of the earth, being produced by the sun's heat, will be necessarily irregular in its flow at different times and places. On the meridian where the greatest amount of heat takes place, which is about 2 o'clock in the afternoon, the greatest flow will be produced and this will be greater on the equator than toward the poles, consequently in thus increasing the flow of the current at the equator, a rarity at that point will exist, and like the river or stream of water, the magnetical current on the south and north of the equator will thus be caused to flow more to the direction of that point, bending more to the equator, and consequently in thus changing the current on either side of such magnetic equator more towards the same, the magnetic needle will be changed accordingly, the north end on the north of such equator will be drawn to the westward, while the south end on the south side thereof will also be changed to the westward, and as this change of the current on either side of such equator is the greatest on the meridian of the greatest heat, this change will be less as you recede either way east or west from this point. Therefore, the needle will commence to change its course in the morning, and gradually increase until about 2 o'clock in the afternoon, and then gradually return to its former position at night, while at night, the temperature being more equal, the needle does not undergo any change.

Although the magnetical currents thus change their course on either side of the magnetic equator, yet at such equator they are not changed, consequently the needle is not changed during the day at that point. This diurnal change is greater during the summer than the winter months, on account of the excessive heat of summer, hence, the magnetic needle will undergo greater changes during the summer than winter.

That as all electric and magnetic currents invariably flow to the right, in the form of a right hand helix around a substance, therefore we may find a solution of the phenomena exhibited by different plants in twining around a support, either in a right or left hand direction, depending on their magnetical or electrical condition. This may be worthy of the consideration of the naturalist.

It is highly probable that the flow of the ethereal current from the earth's ethereal atmosphere down to the solid earth surface, by the sun producing light and heat is in itself more or less electrical, and doubtless may produce an electrical current around the earth's surface in the manner heretofore described, consequently there may be a combination of these two forces that produce the magnetism of the earth, which act in conjunction with each other, and not in opposition.

CHAPTER VII.

Diffusion of Gases.



SIDE from the forces producing chemical union we find other forces governing the diffusion of the gases, yet proceeding from the attractive and repulsive forces operating over the atoms of matter in the molecules of the gases. This may be seen and determined by comparing the atomical forces of the molecules of the gases at different distances from their source of attraction or repulsion.

To illustrate, let us take a gas molecule with the negative say 4 times as large as a positive atom, and the 4 positive atoms uniting with the negative according to their relative forces, etc.; the negative and larger one, being of the diameter of twice that of the positive, and of materiality equal to the 4 smaller ones, the 4 positive atoms. We will now estimate the relative forces of each atom. To determine this we must bear in mind that the laws of attraction and repulsion decrease as we recede from the central point of attraction or repulsion, as the square of the distances intervening the said point or the source of attraction or repulsion inversely. Now in this proposition we have 4 positive atoms and 1 negative atom. The 4 positive atoms have the same attractive and repulsive force as the 1 negative, and if the 4 positive atoms were located at the same distance from a given point, outside of the molecule by the side of the negative, the attractive and repulsive forces of the 4 positive atoms would be equal to the attractive and repulsive forces of the negative atom at all points.

as you recede therefrom, but as it is, the positives being located around the negative atom according to the laws of attraction and repulsion at equal distances from each other, therefore cannot be. (See Fig. 5 opposite Page 86.)

We find as we recede downward from said molecule, which will be the easiest way to calculate the forces of said molecule, (yet in any other direction will produce the same) the following results. We will first estimate the forces of the negative atom by cutting it into halves. Now at Point 1 we have the lower half which is equal to 2, (calling the force of each positive 1,) while receding to the Point 3, which is at a distance of three times the radius of one positive atom, will be equal to the square of 3, which is $\frac{2}{9}$, and the upper one-half being when brought to the same Point 3 five times the radius of one positive atom, will be equal to $\frac{2}{25}$. Now $\frac{2}{9} + \frac{2}{25}$ will measure the negative forces of the negative atom at Point 3, and the positive forces will be as follows:

The positive atom C at said Point 3 will be represented by 1, and B and E, each being four times the radius of the positive atom, therefore will be $\frac{2}{16}$, and D, being situated seven radii above Point 3, will be $\frac{2}{49}$. Therefore, the positive forces of the 4 positive atoms will be $1 + \frac{2}{16} + \frac{2}{49}$, and the negative forces as above stated $\frac{2}{9} + \frac{2}{25}$, showing that at Point 3 the positive forces are more than double or twice that of the negative. Consequently the molecule is in a positive repulsive condition. But as we recede downward from said Point 3 to a point equal to 33 times the radius of the positive atom, we find by actual calculation that the negative forces are in excess of the positive, and will stand as follows: negative, 9,218,447,920,948, as against the positive which stands 8,576,991,753,225.

As the negative forces prevail at this point, they will also be in excess of the positives at all points beyond it, consequently all gaseous molecules of the natural gases at close proximity thereto will repel each other, but at certain

points, (which will be different in different gaseous molecules, which will be controlled by their molecular constitution), their repulsive and attractive forces will be in equilibrium, and 2 gaseous molecules of the same substance among the natural gases, will repel each other to a certain distance from each other, and if not interfered with by other matter will then remain at rest. But when we come to the artificial gases we find them governed by a different law, which is agreeable to their molecular constitution. Their molecules are at all times and at all distances in a positive condition. This is from the fact that the negatives of the molecules of such gases are so small that they never can exceed the positives in force at any distance from their molecules.

Having thus considered the molecular forces of the gases, and determined their forces under certain conditions, we will next notice how these forces produce the diffusion of the gases.

We have determined above that the molecules of a gas, such as oxygen, within a certain radius is in a positive state, beyond which it is in a negative condition or state, and this radius is not the same with the molecules of all gases, it being different in the molecules of different gases. That being the case, it follows that no two molecules of the same gas can at any distance attract each other, although at certain distances they may be in either a positive or negative condition, because they at the same time exercise in regard to each other either a positive or negative force, and as like repels like, hence they will either positively or negatively repel each other. The sphere of positive influence of each molecule being the same, while in that sphere they will positively repel, and both in passing out of it into a negative state, pass out simultaneously, therefore, both being negative will negatively repel, consequently will be always repulsive to each other. But such is not the case with molecules of different gases, possessing unequal molecular

forces. Thus, suppose a molecule of one gas should be in a positive state at the radius of $\frac{1}{1000}$ of an inch, beyond which it becomes negative, and that of another being positive at a radius of $\frac{1}{800}$ of an inch, beyond which it is negative. Now on placing these two molecules together, they at first both being positive would repel each other to the distance of $\frac{1}{1000}$ of an inch from each other, but no further, because the first molecule beyond that distance passes over into a negative state, while the other remains positive; they will, consequently, attract each other at that point, because one is now in a negative and the other in a positive state, unlike attracting unlike, and they will continue to attract each other while they are outside of the $\frac{1}{1000}$ of an inch, and within the distance of $\frac{1}{800}$ of an inch from each other, but if they are outside of the distance of said $\frac{1}{800}$ of an inch from each other they will both be in a negative condition. They will consequently negatively repel each other; hence the diffusion of the gases.

The artificial gaseous molecules, as we have seen, being at all distances in a positive condition, will be attracted by all natural gaseous molecules at certain distances; the natural molecules being in a negative state at such distances, such molecules in their negative state will attract the molecules of the artificial gases which are always in a positive state.

This law of gaseous diffusion being in proportion to the square root of the specific gravity of each gas respectively is precisely in accordance to the molecular constitution of the gases as herein set forth. (See Natural and Artificial Gases Considered.) The above shows also why the molecules of the metals in a gaseous state are positive to those of oxygen, and are attracted to the negative pole of the battery, while those of oxygen being negative excepting at minute distances, therefore are attracted towards the positive pole of such battery and escape at that side. We have said that molecules of the same natural gases can have no

attraction for each other. This is the case only when the molecules are in the same molecular condition, or of the same temperature, they will then possess the same positive or negative predominance at certain fixed points, but if one molecule is raised to a higher temperature, possessing more positive materiality, consequently being in a higher positive predominance at the nearest approach thereto, therefore according to the second case referred to above, where the positive forces were increased one-fourth in comparison to the negative at such nearest point to said molecule, the sphere of positive influence would be increased proportionately as regards its predominance over the negative, and the molecule would not be in a negative predominance at so near a point from the same, as where the molecule was in a less positive state in the commencement, or of less temperature. Hence the two molecules would stand in the same relation to each other as in the case cited where the two differential gaseous molecules were brought into the sphere of their molecular influences, subject to the same laws, consequently would at certain distances attract each other, therefore in all cases the diffusive capacity of the molecules of any gas, whether of the same kind or not, will be exactly in proportion to the square root of the specific gravity of such gas to which the molecules belong, and if the specific gravity is changed by temperature, the proportion will be changed also; greater the temperature less the specific gravity of the gas, and vice versa. Thus the molecules of one natural gas of different temperatures will diffuse among each other. Those of the greater temperature will diffuse with those of less, while those of the same will constantly repel each other, therefore will not diffuse.

As an illustration of the change of a molecule from a positive to a negative state, let us compare the relative forces of the earth and moon, when the latter is between the earth and sun. The earth being about 65 times larger than the moon, its attraction will be 65 times greater at

its surface than that of the moon at its surface, while the earth's attraction at the distance of the moon, or at the moon's surface, is 55 times less than that of the moon at the same point, and at the sun that of the earth is nearly 1,000 times greater than that of the moon.

This shows the peculiar relations of space to the laws of attraction, clearly illustrating why it is that a minute natural molecule of a gas may be positive at certain distances, while at more remote distances will be in a negative state, because of this space. In this example the moon, though 65 times smaller than the earth, has an attraction 55 times greater than that of the earth at the same point at the surface of the moon, because of space, yet as you go beyond this point and reach the sun, that of the earth is 1,000 times greater than that of the moon.

Likewise a natural gaseous molecule changes from a positive to a negative condition by reason of this space, as heretofore described. And if the heavenly bodies are in a superficial highly positive condition why should they not follow the same laws, being attracted at remote distances and repelled by each other at closer proximity or distance, consequently would not come in contact with each other in their revolutions? Hence we may never fear that the comets will ever strike the earth or sun.

CHAPTER VIII.

The Solar System Further Considered.



JUST previous to the publication of this work I deemed it advisable to extend this treatise more particularly to the sun and planets in our system, which was not fully treated of in the foregoing considerations in relation to these universal forces in nature. That the same matter in motion is the product of light, heat, electricity, magnetism and also sound, is clearly evidenced by the fact that one may be changed into the other and vice versa. Also that sound cannot be conducted over a wire to any distance without an electric current.

The reader should bear in mind, that as the attraction of the sun and moon upon the waters of the ocean produce the tides of the ocean, therefore that attractive force would produce tides of the gaseous atmosphere that surrounds the earth also, and the repulsive force over the ethereal atmosphere would produce like tides, which may produce the beautiful glow light just before sunrise and just after sunset, similar to the aurora borealis. Hence, we may conclude that there is a continuous rising and falling in the two atmospheres; while one is rising the other may be falling and vice versa.

The foregoing problems in relation to the attractive and repulsive forces in the atoms of matter have been principally considered in relation to the surface of the earth; that is, the *modus operandi* thereof at that point, yet we

find that a gaseous molecule at the surface of the earth does not contain at that point the same amount of positive matter, (say at the poles of the earth, where the sun's influence has but little to do in keeping up the heat at said surface,) as you ascend to a higher latitude; said molecule takes on more positive material, inasmuch as the atmospheric pressure is being removed, in the same manner as we find it occurring in removing the pressure by artificial means. Hence it follows that the upper portion of the atmosphere is in a more highly rarified condition, and more and more so as you ascend, and is the greatest at the upper portion where it is in a most highly rarified condition. Then commences the great atmosphere of ether, which according to the gaseous atmosphere, is also more rarified at the highest and outward point, where it is in a highly rarified condition and susceptible of being moved by the slightest repulsive force by any foreign body.

Now it is highly probable, and not impossible, that at the nearest stratum of this ethereal atmosphere may, and probably does contain some of the molecules of solids, as iron, etc., which at the surface of the earth exist in a solid state, yet at this point are in a gaseous state floating in the lower stratum of ether as they originally existed, before the solidification of matter into orbs commenced. These little negative atoms would hold in combination surrounding them many positive atoms, and they would be in a highly rarified condition, just a little heavier than the ethereal atmosphere, and therefore circulating in its lower stratum. These molecules, when concentrated, may produce dark spots or clouds, which we have heretofore considered to be in the sun's atmosphere, and by an occasional rapid concentration by the tumultuous movement of this ethereal atmosphere these molecules are condensed into solids, and occasionally fall to the earths' surface—called meteoric stones.

While these molecules thus consolidating and being pre-

cipitated to the earth's surface, and diminishing the amount in the ethereal region, yet their place doubtless is being supplied by the volcanoes of the earth, which send up these gaseous molecules through the hot current of air to the upper portion of our gaseous atmosphere to the ethereal atmosphere. Consequently, the ethereal atmosphere is more or less supplied with this material, while these molecules could not exist in this state at the surface of the earth, or in the gaseous atmosphere, especially in the lower stratum thereof, on account of the atmospheric pressure, with the tendency of matter to seek an equilibrium of its forces. Yet such molecules could exist at the point above designated, after being transmitted or carried up to that lower ethereal stratum through the channels of heated air produced by volcanic action, especially at their extreme turbulence or eruption.

These clouds would be carried westward by the tidal wave of the ethereal atmosphere, as the earth turns eastward, causing apparently dark spots on the right limb of the sun. They are the same as described by Prof. Young, the astronomer, cited at the introduction of this work, which have misled many into supposing the dark spots produced by such clouds to have been the product of the sun's atmosphere.

We have seen that in removing the air from a cistern or tube and producing what has heretofore been termed a vacuum, that it is properly termed a vacuum as regards all matter, except the ether of the universe, but as regards the ether, it cannot be excluded. It will pervade all space and therefore fill the cistern or tube of excluded air. By removing the air we make room for more ether or positive material. And as this ether set in motion produces light, therefore by rapidly setting in motion the ether in such cistern or tube by constant and rapid agitation or condensation, light can be produced, which may be the most economical way to produce artificial light, and perhaps heat.

Experiments in that direction will determine. Thus by passing an electric current through such vacuum tubes light can be produced. The current setting in motion the ether, or positive matter, and by continuing the process the tube is being kept full of ether and is radiated through space, producing light, etc.

In conclusion we will say that we found that matter first existed in an elementary state, its atoms distributed through all space and set in motion in one harmonious direction, and as there was more positive than negative material to that extent that all matter was brought into a gaseous state, and in the coming together and concentration of this gaseous material under the motion imparted to it in the beginning, bodies were formed of different sizes, the largest one, like our sun, constituting the center of our system, around which revolve the earth and the planets with their satellites, all moving in the same harmonious direction around the sun, and the satellites also around their planets in the same course to the right; all the result of a force imparted to materiality in one common direction.

This harmony of motion is a striking proof of a hand behind materiality which is the first cause—Deity. Here we find the heavenly bodies in their first stage in a gaseous state; the earth also. Then we find most of these gases condensed into a molten mass, and as further condensation goes on, the solid earth and water appears, with its attendant gaseous atmosphere surrounding the earth, and at the same time the ethereal atmosphere is produced, made up of the excess positive material, which was not required to form the solid, likewise a gaseous portion of our globe. This ethereal atmosphere being made up of elementary positive material, whose atoms are repulsive to each other, yet are being held in their place above the earth's gaseous atmosphere proper by the attraction called gravitation. The earth's ether in this great ethereal atmosphere of the earth being set in motion by the sun's ethereal atmosphere as

heretofore set forth, produces the sun's light and heat to the earth, and as this force extends outward towards the poles of the earth, it also produces an ethereal tidal wave over the poles of the earth, producing the great northern lights, the aurora borealis, and this tidal wave also produces the difference in temperature in the upper portion of the atmosphere, being warmer at the poles than at the equator of the earth, as has been experimentally determined by scientific investigation.

We have found in this treatise that the molecules of natural gases in their uncombined state with other matter, are superficially in a positive repulsive condition; that is, one molecule repels another molecule in this superficial positive condition to a certain distance, and beyond that distance is attracted, producing the diffusion of gases. We might extend this law to the heavenly bodies. For instance, take the sun with its enormous ethereal atmosphere surrounding and encompassing all its other materiality, therefore the sun like a gaseous molecule above cited, is in a superficial positive repulsive condition, and the earth being in the same condition, would it not be a reasonable conclusion that should the earth come within a certain radius of the sun, their repulsive atmospheres would prevent any possible collision, and the earth would continue on its course around that orb? Should this be the case, which is highly probable, we need not fear of any complication with the sun. On no other hypothesis can we account for the wonderful phenomena of the comets in their orbits around the sun. The comets are in a highly superficial positive condition, having very much the characteristic of a gaseous molecule. They come from their long extended journey from the sun in a course almost in an apparent direct line towards that orb, passing between the planets without coming in contact with them, and passing around the sun with lightning rapidity, and almost kissing the orb of day, and then gliding out again on their long journey to come back again in their

due and periodical time of many years, but never passing out of the radius of the sun's attraction.

Hence, we are led to exclaim, Wonderful are the works of the Creator! All is perfection and harmony and yet all things are brought about in the simplest manner possible. Every atom of matter is clothed with simple forces, which are permanent and unchangeable; that every atom of matter is sent out by the hand of Deity clothed with unchangeable power to do the work of His bidding; that every atom is His agent in carrying out the construction of all worlds, their preservation and the continuation of their workings and *modus operandi* without His personal supervision.

Notwithstanding the earnest and conscientious pleadings and petitions of man for a change in the workings of the natural laws in nature, nothing will be stopped on his account. The Niagara will continue to flow, and whosoever approaches in his canoe too close to the falls will certainly go over. In nature there is no respect of person, nor exceptional privileges. The lightning strikes whatsoever is in its course, whether it be a tree, a child, a slave or a monarch; the rich or the poor, the good or the bad—it makes no difference—the laws are unchangeable and all must live under them and submit to them, or abide by their infringement or violation. He who sinks under the water, without artificial protection, will drown; he who gets into the fire will get burned; he who falls off the roof of a high building will get hurt, and more likely killed; he who gets too near a precipice or the cone of a volcano is liable to get killed or seriously injured by falling over the precipice, or into the crater of the volcano.

Thus we find that God has not established a special privilege for some men; that all men must live together under the natural laws which are unchangeable, and universal, throughout all his works and were established in the beginning of the creation of the world and He pronounced them good, and all the change since then has been brought

about through the ultimate and never veering forces imparted to materiality, to the minute atoms of matter in the universe in the beginning. Deity is the first cause, and materiality his agent, through which all the operations in the natural world are carried on, and we must not expect He will change any of these forces to please puny man.

Man was turned out of the garden of Eden and commanded to live by the sweat of his brow, that his success in this world depends on his skill and disposition in using the talents given to him; that all are required to work for what they get here, subject to the same invariable laws, no specialties in nature. If he makes a bad use of the material and forces in nature, he will not get along well, and his financial life may be a failure. But he who makes the best use of the things at his command, or a good use thereof, will succeed, and his life will not be a failure. What comfort we get in this world is to a certain extent our making. The talents given us must be improved upon, and not lie idle, otherwise all will be taken from us, "even that we hath," seemingly indicating that in the end and consummation of this life the one who has done no good here will go down to earth from whence he sprang, "unwept, unhonored and unsung," and that may be the end of his existence, there being no future for the unworthy, that being reserved for the ones worthy of it, the just, the generous, the good.

But let us speculate no further outside of the province of this work, hoping that the reader will forgive in thus doing, while we will endeavor to keep within bounds of the material world, etc., as we further proceed in this work. Yet we must not ignore the fact as we see it, that God is a personal being, and He uses the material in nature as his agents, and has clothed them with powers sufficient to carry out his designs, without his personal supervision, just as we would build a machine and make it run itself, as far as possible, without personal supervision or attendance, using the forces and material in the natural world at our

command, man not being able to produce a machine of perpetual motion, nor one that will last long.

Yet we see the forces in nature continually moving on and on as they were in the beginning, without any cessation. The waters flow into the sea, and are again taken up and distributed over the land, and thus the *modus operandi* is going on continually and unceasingly watering the earth, and keeping the rivulets and streams full, and their waters moving towards the sea to be again taken up and carried over the land, and this process goes on constantly through the material forces in nature and seemingly will continue on forever. The earth and planets are constantly turning on their axes. Their respective satellites flying around them, and they in turn around the sun. All nature seems to be in perpetual motion.

Prof. C. A. Young, deceased, late of Dartmouth College, said in 1872, in his lecture on the sun, that "our ideas regarding the solar constitution and modes of action are based upon mere hypotheses of greater or less plausibility, and I am free to confess that my own studies for the past few years have done quite as much to unsettle for me old beliefs as to establish new ones. While not a few difficulties have vanished in the light of freshly-discovered facts, a still more numerous crop has come up in their place."

"Recalling the remarkable fact that this very periodicity of the solar spots is responded to upon the earth by a corresponding variation of our terrestrial magnetism, it would not be safe at all to assert that planetary influences may not operate upon the sun."

While the sun's spots are visible there are great meteorological disturbances taking place near the earth's surface. Volcanic commotion may prevail. The distance from the earth to the sun is variously estimated to be between 92 and 93 million of miles. A cannon ball, moving straight on unretarded with its swiftest speed, could not make the journey to the sun in nine years.

If sounds could travel through the celestial spaces at the same rate as in our air, then the thunder of a solar storm or the report of an explosion such as occurred last September, might reach us in a little more than 14 years.

And yet across this tremendous chasm the sun exercises his lordship and performs his service; every pulsation of the solar surface is instantly responded to upon the earth.

The diameter of the sun is estimated to be 860,000 miles, nearly 109 times the diameter of earth, which is 8,000 miles. In bulk it would take more than a million and a quarter earths to make a globe equal in size of the sun. The sun's weight is estimated to be 325,000 times that of the earth.

Representing the earth by a boy's ball two inches in diameter, the sun on the same scale would be something more than eighteen feet through. If the earth were placed at the center of the sun the moon would be far within his surface, so far indeed that there would be room within it for another moon almost as far again from the earth.

A comparison between the climates of the present day and those of two thousand years ago based principally upon data derived from the geographical limits of the growth of plants, especially the vine and cereals, shows conclusively that during this period the heat annually received from the sun has not materially altered.

IS THE SUN SUSCEPTIBLE OF ANIMAL OR VEGETABLE LIFE.

This question depends on the condition of the sun in relation to its materiality and its physical condition. As to materiality we must assume all heavenly bodies to be alike in composition, which needs no speculation in that direction. But there are other conditions that demand consideration: 1st—There must be a certain degree of temperature sufficient to sustain vegetable and animal life. Also sufficient light, etc.

As regards the earth we have seen that were it not for the sun, principally, producing light and heat to the earth by the repulsive force of the sun's ethereal atmosphere over that of the earth, as heretofore described, the temperature of the earth would fall below the degree of heat required to sustain animal and vegetable life, and everything would be at rest. The heat of the earth would become latent (so called). Consequently, as regards the sun, the same laws would prevail, and without foreign intervention there would be no activity on the sun; vegetables and animals could not exist on that orb. But as the earth and all the planets have ethereal atmospheres, and their satellites also, consequently, they will have a corresponding influence over the sun's ether producing light and heat; but doubtless not to that extent as produced by the sun over the planets. Yet we find that the materiality of all the planets, their satellites and the asteroids to the number of forty-four approximates the materiality of the sun. Jupiter has a diameter of eleven times that of the earth, Saturn is nearly as large, and Neptune and Uranus are also very large planets, and all the fixed stars have an electrical influence over the sun also, as well as over each other, producing light and heat by setting in motion the ether of space, and that in the atmospheres surrounding the various orbs, as well as that of the sun.

Hence, we can see that there will be activity in the sun as well as all the orbs in the heavens sufficient to produce and sustain vegetable and animal life providing other things are agreeable. As the ethereal atmosphere of the sun is so many more miles in height than that of the earth's ethereal atmosphere, consequently at the upper portion must exist in a very rarified condition, far exceeding that of the earth, therefore would be disturbed by the slightest repulsive force and would not require as much force to produce the same disturbance as would be required over the earth's to produce the same light and heat. Yet it is rea-

sonable to conclude that the light and heat produced by foreign influence over the sun as above stated, comes far short of that produced over the earth by the sun, included within the same surface. Therefore we may infer that the eyes of the animals of the sun would have to be more susceptible to vision than they might be able to see in the less illuminated orb. But we have said that if the sun's heat at its surface, regardless of foreign influence, is in the same condition as that of the earth at its surface, regardless of foreign influence, no living thing could exist there, and as all foreign influence combined over the sun would not be sufficient, probably, to raise the temperature of that orb to that degree necessary for organic life, hence we must look for a source, if any, that we have not heretofore considered.

Can there be any according to the universality of matter, and the forces that are coherent therein, as considered heretofore in this work? If not, then we must conclude that the sun is not inhabited, nor is it capable of vegetable life. Can there be any difference in the size of orbs as regards their heat at their surfaces. Let's see; the problem may be solved here. Let us compare the surface of bodies and see what relation, if any, they stand to the condition existing at that point in relation to their temperature. In considering the earth's central heat, we have concluded that the greatest degree of heat was located above a certain point where the earth's attraction for positive matter was balanced by the gravity of matter upon matter, (see the Earth's Central Heat considered), and that from that point upward to the surface a gradual decrease in temperature has been found up to the invariable stratum, and that invariable stratum would be the surface of the earth, were it not for foreign influence, such as the sun over the earth's surface.

Now to test this important question whether a larger body will be in a different physical condition at its surface

than a smaller one, we will have to compare the surface of the smaller body with that of the larger. We have seen that on the earth the greatest degree of heat exists near its surface and extending down a certain number of miles, and below that an even temperature to the center, and according to the forces operating over the atoms of matter could not exist in any other way. Now if the surface of a small body, in proportion to its materiality, stands in the same relation to that of the larger body, there can be no difference in the surface heat of different bodies, large or small, but if there is a difference then we must note what would follow such a condition of things.

The only way to solve this problem is to compare their circumferences with their materiality. The circumference of the earth is 25,000 miles and that of the sun is estimated to be 2,700,000. This probably includes its atmospheres, for we find that such a body if it consisted of the materials existing in the molecules of the earth, its gravity would be five times what it is estimated to be; its gravity according to such estimate is only twenty-two times that of the earth and should be, according to its size, thus estimated 110 times that of the earth, assuming it to be of the same density as that of the earth. We will assume the diameter of the solid portion or nucleus of the sun to be, in accordance to its mathematically calculated gravity, twenty-two times the diameter of the earth, which would make the sun's diameter 88,000 miles, the solid portion thereof, and its circumference about 270,000 miles to that of the earth's 25,000. This would be in the proportion of 1 of the earth to about 11 of that of the sun. Thus the sun's circumference would be only eleven times that of the earth, yet its gravity would be twenty-two times that of the earth—we call the gravity to represent the difference in materiality of these two bodies.

Thus we see that the materiality or size of bodies does not correspond to the size of the surface of such bodies.

This may be readily comprehended as follows: take a cubic foot for instance, its surface would be four superficial feet. Now take eight cubic feet, and this would make a block two feet across either side and would make each surface to contain four superficial feet, and the four sides would make sixteen superficial feet. This would make the comparative size to its surface 8 to 16, which would be reduced 1 to 2, consequently its surface is only twice that of its contents, while in the former case the surface is four times its contents.

Hence we see that the surface of bodies does not correspond to their materiality; that a smaller body has more surface than a larger body in proportion to its materiality or contents, and as 1 to 22 represents the comparative materiality of the earth and sun and 1 to 11 their contents superficially, therefore the surface of the sun is less by one-half than that of the earth in comparison to their materiality. Hence it follows that if the excess positive atoms like that of the earth's central heat is located in the sun in conformity to the laws operating over the molecules and in the atoms of matter, there will be twice the amount of that of the earth located at the surface of the sun, sufficient to perpetually keep that orb at its surface in condition agreeable to the production of vegetable and animal life; sufficient to keep water in a fluid state; sufficiently warm for organic propagation, and the atmosphere of like agreeable condition.

This same principle may be extended to the planets. We find that the largest planets are furthest from the sun and would not receive as much foreign influence as regards their temperature as the smaller ones, yet by this principle and law operating in the sun as above stated, would cause them to be of a greater temperature at their surface than that of the earth at its surface, and to cause them to be in condition to sustain life it would not be required to submit them to any great degree of foreign influence, their surfaces being so warm like that of the sun.

This distribution of the planets, the larger ones more distant from the sun, forcibly shows a providential hand in the works of nature. In view of these considerations, we must look upon the sun as having a delightful climate, not subject to the extreme changes we witness here on the earth—perpetual spring—which must be delightful to live in.

It might be claimed by some that inasmuch as the gravity of the sun is twenty-two times that of the earth, that the sun's superior gravity would cause the excess positive atoms of the sun to be attracted and held to a greater depth below the sun's nucleus, than would be the result of the gravity of the earth over the excess positive matter of that body at its surface. This can easily be shown to the contrary. It will make no difference what the gravity of a body may be at its surface, whether it may be more or less than any other body, the excess positive material will be equally attracted with the whole mass of matter, and the same rule will apply as illustrated and considered under the head of the Earth's Central Heat, to which the reader is referred for further light on this subject.

Therefore as matter is universally alike in all worlds or nearly so, and as the forces operating over all matter in the universe are the same, whether it be in the earth, the sun, or the planets, or any celestial orb, consequently the greatest degree of heat of any orb will be at a common or equal point below its surface, and larger the body or orb, greater will be the heat at its surface. The sun's surface heat is the greatest in our system, Jupiter next, then comes Saturn, then the next in size and so on through our system as regards the location of the same through the forces existing in the atoms of matter, regardless of the changes produced by foreign influences over them, as has been elaborately considered in this work in relation to the earth.

That the planets nearest to the sun will be more forcibly affected by the sun's influence over them, and as their surfaces contain the lesser amount of excess positive material,

(as they are among the smaller planets in our system), therefore seemingly being placed nearer the sun for the purpose of elevating the temperature at the surface of those orbs, in order that they might, like the earth, be susceptible of the sustenance of vegetable and animal life, and the larger planets further away as they do not need so strong a foreign influence to make them capable of sustaining animal and vegetable life, as would be required on the earth and lesser planets.

In this, as in all of God's works in nature, we can see wisdom and economy pervading all things, conclusively proving to us finite creatures that nothing is made in vain "that is made"; that we do not live in a chance world; that the laws of nature are invariable and unchangeable; that the workings of nature are the same today as yesterday; that God made the world to run from the beginning without his personal supervision, or the least supervision possible, and we must not expect that he will change the *modus operandi* thereof for the mere accommodation of puny man, and it would be the height of folly to expect it; that there are other worlds than ours, millions of them, and therefore he has regards for other creatures aside from terrestrial ones; that He sits in his divinity in the center of the universe overlooking all worlds, around which all the orbs of the starry firmament revolve in their journey of millions of years, and will move on forever.

Prof. David Todd says that "the little we know of nature's workings on the earth points with practical certainty to her gifts of life to every nook and crevice of the cosmos, where it is ready to offer her a foothold. All the more on Mars where conditions cannot be very dissimilar to the lofty mountain heights of the Andes, where I found man and many types of animal and vegetable life enjoying a useful existence, in spite of what Professor Lowell excellently calls 'pronounced inhospitality of environment.' But all were unconscious of it, because it had come to them through

countless generations. Even the crucial question of temperature has been reinvestigated by Professor Lowell, with fuller cognizance of all the elements concerned; and it now seems certain that Mars, in spite of his greater distance from the sun, enjoys an average surface temperature not very inferior to that we know here on the earth.

I am free to say, too, that the canal and oasis system *in toto*, as looked at steadily night after night, impresses me more and more, not as a natural but as an artificial system, wholly or in part."

Were it not for the consideration that the larger planets are of a higher degree of temperature than the lesser ones as Mercury, Venus, Earth or Mars, in their natural state, irrespective of the influence of the sun or other foreign influence, it would probably be impossible for them to support vegetable or animal life on account of their distance from the sun, Jupiter being 490 million miles distant from the sun, Saturn 900 million, and Uranus and Neptune much farther, while the earth is only 93 to 95 millions of miles away from that orb, the sun. It would seem that they were placed in their position in the heavens at proper distance from the sun that would be agreeable to the requisites of temperature that would be required for animal and vegetable existence; that the loss of the sun's heating influence over them on account of distance, is made up by the superior coherent temperature of the larger planets themselves, that it would not require so much foreign influence to bring them into the proper temperature required to produce and maintain life existence.

We believe there is nothing made in vain, that the Creator did not place the stars in the firmament merely for our pleasure to admire and look upon and that only, but that every nook and corner of the cosmos that is susceptible of a foothold is presented with the gift of life.

While the cosmical aspects of geology, in relation to the composition and size of the orbs in our planetary sys-

tem, may be and is to a certain extent speculative, yet I desire here to notice the proverbial error astronomers have arrived at in relation to the comparative density of these orbs in our system. Their densities are arranged thus: the planet Mercury, 1.12; Venus, 1.03; Earth, 1.00; Mars, 0.70; the Sun, 0.25; Jupiter, 0.24; Saturn, 0.13; Uranus, 0.17; Neptune, 0.16. The reader will observe that the relative density of these bodies, as thus designated, are in opposition to the natural accumulation of matter upon matter of the same weight or gravity, the larger the body greater would be its density, or certainly not any less on account of superior accumulation of matter of the same weight. Doubtless the sizes of these orbs have been calculated from their respective diameters, including their atmospheres, and not being confined to the solid portion or nucleus of those bodies, consequently the above figures do not represent the comparative density of those bodies in relation to their solid mass, but includes their gaseous and ethereal atmospheres also.

The solid portion of the sun is as dense as the solid portion of the earth, without a doubt, which is in accordance to the theory of the universality of matter and the forces applied thereto, in all orbs in the universe; that there are more worlds than one, where vegetable and animal life exists; yea, many of them, and as numerous as the sand of the sea shore. Every fixed star, so called, is a sun to other worlds, and each has its quota, and when we think of the milky way (*via lactea*) powdered with stars, we are led to exclaim, Wonderful are Thy works, Creator of the Universe, none can mount up to thy mysteries! Reasons brightest spark, though kindled by Thy light, falls short of comprehending Thee! and we are all led to exclaim, What art thou, Man, that thou art mindful of Him on this little terrestrial sphere, one of the smaller planets in our system!

A quarter century of catastrophe has shown that the internal forces of the earth have not abated since the record

kept by man, carrying with it so clearly the conception of the unfinished globe and so eloquently shows us the inconsequence of man to the titanic forces of nature. In August, 1883, an earthquake rent asunder the island of Krakatoa and caused a shock throughout almost the entire mass of the earth, which shaped the interior of our globe, was still tending to produce equilibrium. By this catastrophe 40,000 or more persons were swept off the earth. The ash from Krakatoa had hardly settled when came the reawakening of Tarawera in New Zealand, a volcano whose activity had been supposed to have been ended for over 100 years. Then followed the disaster to Charlestown, S. C. Then came a number of shocks noted in the nineteen years, chiefly in the field of Japan, between 1885 and 1903, in which 27,000 lives were lost. Then came the decapitation in 1888 of Bandai-San, and the hurling of its vast mass over miles of inhabited lowland, which was followed the succeeding year by the great movement of Kumanoto, and two years afterward the great earthquake in Japan when 1,000 lives were destroyed, and within three years came another at Tokio in 1894. Then came unrest in Vesuvius, Etna and Stromboli. Also in a number of volcanos in Central America and the Hawaiian Islands and the mountains of Alaska and Colima, Mexico.

The events in the year 1902 are still fresh in the minds of most people, at Chelpancingo in Mexico, Quetzaltenango in Guatemala, the eruption at St. Vincent on May 8, of Pelee, with the annihilation of St. Pierre, with the razing of Morne-Rough and other villages in Martinique and the earthquake of Shemaka and of Andigan. The result of it all was the death of some 50,000 to 60,000 persons, and in the same year the destruction of nearly all of the inhabitants of the island of Tari-Shima in Japanese waters as the result of a volcanic explosion. This was soon followed by those vast disturbances in Formosa and culminated in the devastation of the greater part of that island in 1906, and thousands of lives were lost.

Preceding these calamities by a few months, was the earthquake of the Manteleon region in south Italy. Then Vesuvius followed Stromboli, opening up a new chapter in the record and closed it with the outbreak of April, 1906, which probably surpassed all other eruptions of that volcano in violence and destruction, except those of the year 79 and 1631. Then followed the tragedy of San Francisco. Then, about four months thereafter followed the greater catastrophe of Valparaiso in Chili, 1906. Then came the mine disturbances in Ecuador, Columbia, and in the island of St. Lucia a great part of the city of Arica lay in ruins, and with the beginning of the year 1907 came the reports of the eruption of Mauna Loa and Etna, the flowing of lava from Savai volcano in the Samoan Islands, and the conversion of the island of Jamacia into a mass of debris. The destruction caused by these subterranean upheavals during this quarter century has caused the loss of not less than 125,000 to 150,000 lives, possibly much larger, the records being incomplete.

We not only find constant changes going on in the superficial structure of one planet produced by the volcanic and subterranean forces, producing earthquakes, etc., but constant changes are going on all over the surface of the earth, produced also by the attractive and repulsive forces operating over materiality, defying the skill and ingenuity of man to prevent it. Rivers are constantly carrying sediment to the sea, and constantly yet slowly, filling up its basin. The Niagara is wearing away the lower channel to the lake and will some day empty out its contents of water and dry land will appear. The rains and frosts of winter are wearing away and pulverizing the rocks at the earth's surface. Yet, while these changes are going on, a tearing down of the present structure superficially, there is a building up in some quarters of the globe. Rocks are constantly being formed out of the breaking up of the old and thus we see the same forces that build up, also tear down. By these

forces water is lifted out of the sea and carried to the land, to be, by the streams and rivers, carried to the sea again, and thus the process is carried on indefinitely.

The explosions produced naturally or artificially, which have not been considered definitely in this work are attributable to the molecular changes in matter resulting from combination of the molecules of matter, producing a spontaneous liberation of positive materiality, as has been shown in the combination of the hydrogen with the oxygen molecules, as shown on plate opposite page 65, producing water. Where a sufficient amount of the two gases are brought together, the liberation of positive matter is accumulated to that extent, that through the repulsive forces of its atoms over each other a mighty lifting power is produced in all directions. All explosives are similar products. Yet it is possible to confine the positive atoms in a compound to the extent beyond the natural affinity of such atoms for negative materiality therein, so that by a certain disturbance, though slight, would cause said compound to give up a certain portion instantaneously, and produce an explosion, hence an explosion is the product of a spontaneous liberation of the same kind of matter whose atoms are repulsive to each other, producing an outward repelling force.

Many different compounds may be produced by the union of the gases with each other, and also with the solids. Some are permanent and others are only temporary, and many times two or more elementary substances may be combined in a compound according to their molecular constitution, called chemical combination, a union according to the physical forces of matter. The alloys are simple mixtures of different metals united by the intervention of positive atoms intervening the differential negative atoms, irrespective of size, or physical forces. The oxides are very numerous. Their product is simple enough; we have only to conceive an oxygen molecule powdered, as it were, with

the negatives of a metal, such as iron for instance. The molecule of oxygen being in a superficial positive condition (see oxygen molecule opposite page 65,) stands ready to attract the minor negative metallic atoms to itself and produce oxidation. Chlorides and fluorides, etc., are products from the same *modus operandi*. Oxygen constitutes about 23 per cent. of the air, 88 per cent. of water, and one-half of the rocks of our globe.

The compound molecule of water, consisting of a molecule of hydrogen, (the lightest of all substances), immersed as it were in oxygen molecules, produces a compound molecule, containing more negative than positive material, hence in a concentrated condition. It being in that condition shows why it is more susceptible of the various changes, from freezing to evaporation. By removing a few of its positive atoms it is converted into a crystal, (see plate opposite page 77 and 86), and by the application of heat, (positive matter in motion), water can be easily converted into steam by the surplus negative atoms' affinity for positive matter. Hence, its many different forms in nature: from ice to liquid, and then by becoming more positive is converted into a vapor, or steam, and on being carried up into the higher elevation becomes floating clouds to be condensed again and fall to the earth's surface, irrigating the land and filling up the streams and rivers and keeping up their constant supply of water and flow. Without these two elements the earth would be a barren waste, and the exclusion thereof from any orb the same results would follow.

We have heretofore shown the construction of a gaseous molecule, consisting of a negative atom surrounded or powdered with positive material, or atoms, the negative forming the nucleus, as it were, the center or core of such molecule, and the positive material surrounding the negative, causing it to be in a superficial positive condition, which necessarily will be more or less positive under certain con-

ditions, as has been previously herein considered. Hence, such molecules are always in a state of irregular agitation, depending on the amount of positive material in each molecule, the negative of the same not being changed.

This shows that the gaseous medium is not at all times of the same proportional quantity as regards its constituents; the more positive matter in a molecule lighter it is, and will ascend to a higher elevation, the lesser descending to the lower stratum of the gases. In this we can see the distinction manifested in the two media, that of the air and that of the ether. The ethereal medium is made up of the positive atoms alone, while that of the air, or water, is the product of the negative and positive material combined in simple or compound molecules. Consequently the ethereal medium when set in motion, the vibrations of its particles will be interfered with by the attraction of negative matter when it passes through the air, water or other transparent media.

This shows why light is impeded in passing through the atmosphere many times its original activity, and through water much more, on account of the negative materiality existing in the air and water with which the light, (positive matter in motion), has come in contact, and thus impeded its progress, and to a great extent weakening the force originally imparted to it. Light passing through or falling upon any material substance, such body is more or less affected thereby. Some absorb most of the light and will gradually become warmer. Such a body is said to be of a dark color. Others reflect the light in different degrees, absorbing a certain portion thereof. This produces the difference in the appearance of the surfaces of the various bodies in nature, which we call color, and which we have heretofore considered.

We live in an "ocean" of ether. It is all around us, above and below us, and doubtless extending through all space. Every nook and corner of the universe is filled up

with it, that is not occupied by other matter. There is no vacuum in nature; certainly not in the earth or atmosphere. Thus we can easily comprehend the effect of the disturbance of this great medium at any point. The whole mass will be effected thereby, like the effect produced by casting a pebble in the ocean: little waves will flow in all directions, their intensity depending on the force behind them.

Thus the waves of light are brought to the eye and sound to the ear, and that peculiar sensation we call odor to the senses, heat to the body, by which we are enabled to discern and comprehend things around and about us; their beautiful color, the melodious song of birds up to the mighty roar of the Niagara, while the perfume of every petalled flower in our midst may come to our senses, admonishing us of the fragrance, the beauty, the melody, the power and the forces operating in the natural world. The wonderful and energetic effect of sunlight, (which is pure electric light), over animal and vegetable life shows the harmonious connection and explicit relation of all other matter with the ether of the universe.

WHY YOU SHOULD NOT SNUB A BOY, OR ANYONE.



HY snub a boy because his home is plain?
Perhaps his father's cottage may, in main,
Be built of logs, and low and roughly made,
And in the forest reared near some cascade,
Or in some lonely inconspicuous way,
Known to the woodman only, as it may;
Yet, let's remember, as we must and should,
That palaces, though grand and great and good,
Are not the places only, that are found
The glowing traces of the noble mind—
A cabin built of unhewn logs suffic'd
To shelter Lincoln* in his early life.

Don't snub a boy because his clothes are poor—
The greatest minds come not from wealth's deep store;
The poorest boy may make the noblest man,
Then gently, kindly treat him if you can,
And should you see in winter's cold embrace
A boy in linen clad, and him to grace,
Though it be in the city's crowded street
Of noted Boston you may chance to meet
This one so thinly clad, should it be so,
An Edison† it may be for ought you know,

*Abraham Lincoln's early home was a log cabin.

†When Edison, the inventor of the telephone, first entered Boston he wore a pair of yellow linen breeches in the depth of winter.

The great inventor of our age and day,
(Soon yet to be), then cheer him on his way,
Aid, assist his noble thoughts to rise
To their aspiring greatness 'neath the skies.

Don't snub because his parents are untaught
In skilled science, or of this world of thought
Their minds conversent less of things more grand
Than the more common ones throughout our land;
For such a boy, that you may chance to meet,
In cottage lodged, in hall, or on the street,
May be Shakespearian* in giant strength
Of mind, of noble thought and power to think,
To write the poet's glorious song of praise,
Or follow out his wisdom and his ways—
A father's failure to subscribe his name,
Will not endarken a Shakespearian fame.

Snub not the boy whose humble trade persues,
Vocation common more than some of you,
Or fills a place in this our world's routine,
Less honored than some other, that the mind
May fix upon—a tinker's trade, perhaps,
He is to follow, yet after time has lapsed,
And hence the boy to manhood he has grown,
And tender breezes o'er his breast hath blown,
The unsuspected youth becomes a man,
To wield the pen, as such, none other can—
The Pilgrim's Progress† is his noble theme,
And thousands made rejoice, his words esteem.

And should the boy from causes not his own,
Disabled be—perhaps his sight has flown,
And the green earth, with all its glowing charms,
That once embraced him in its outstretched arms,

*Shakespear's father could not write his name.

†The author of Pilgrim's Progress was a tinker.

And cheer'd his heart in times of sad'ning grief,
Gave to his soul desired heartfelt relief,
And taught him how his sorrows to forget
In admiration of such scenes, and yet—
But as the light of day no longer shines
Into those eyes, as once—the wealth of mines—
And he is left as best he can or may
To plod his journey on, the life-long day,
And unseen paths his feet perchance may tread,
Directed, guided by and faithfully led
By noble Carl,* his best and truest friend,
Whose confidence he has, his help to lend.
Can there be one whose guilty heart would chide
This humble youth, yet low, with light deny'd,
Because he stumbles on his destined way,
From causes which no thought can drive away,
Or no precaution his, can give relief,
To this his fated fate, his grievous grief?
Should there be one, let him take note of this,
And counsel take—it will not come amiss—
That Milton's high poetic songs and lays
Of Paradise Lost, of other ancient days,
Came from a noble and gigantic mind,
And not less worthy for, that he was blind.

Snub not because he makes less progress in
The sciences the honors thus to win
In early youth, and seemingly be dull
In lessons taught from books at public school.
Should these things be the heritage of some
That we may chance to meet beneath the sun,
Let's bear in mind these facts before we chide
Or blame unjust for seeming might deny'd,
That minds of aptitude, less brilliant far,
To others shining, youthful, radiant star,

*His dog.

That shone with such peculiar glare,
That made us think 'twas superior far,
May not hold good, as coming time rolls on,
Nor win the race so eagerly begun.
With books the Hogarth was a stupid boy,
Yet an engraver, he was no alloy,
And as a painter he was scarce excelled
By living mortals that we e'er beheld.
Then pass no thought of what the boy may be,
From early youth, from things you may not see;
But give him help, and cheer him on his way,
Encouragement you give, the more you may,
And Heaven will bless you for your generous care,
And help to those, who seeming need it more.

There comes a boy with stammering tongue to swing
And tries to tell us of some wond'rous thing.
He does his best, his thoughts to use convey,
Yet wretched work he makes, as well he may;
His tongue seems tied beneath the hollow space,
And hence his language comes without much grace,
And falls with special notes upon the ear.
If we should understand, perchance to hear,
And we may inconsiderately be beguiled,
To smile, and muse ourselves a little while,
Perchance to blame, and foolishly to chide,
This boy for things he cannot help, nor hide—
Let's not indulge in this unkindly way,
And carry things too far, as thus we may,
But bear in mind as well we ought and should,
Demosthenes,* in spirit, as he could,
Might rise before our all astonished gaze
And challenge us to duty, and to raise
Our low'ring spirits to a higher stand
On this terrestrial sphere, our native land—

*Demosthenes, the great orator of Greece, overcame a harsh and stammering voice.

To teach us that a doubtful stammering tongue,
The gift of nature to, an humble one,
May yet be made to speak with glowing praise,
And be the heir of oratory and its ways.

Let not these be reasons only
Why we should not snub a boy;
There are others not remotely
That would lead us to employ
Our attention, and more kindly,
Toward our brother, or our friend,
Rather than to go it blindly,
And our kindred hearts to rend.

We should give assistance kindly,
To hold up the gropeing flower,
To refuse would be unmanly
When that need demands our power.
If we cannot give the needy,
Gold that's not at our command
Why can't we be always ready
To proffer forth a helping hand?

We may give a world of kindness
That may cheer the drooping heart;
This will cost us naught but mindness
And a heaven to some impart.
Then let every one remember
That which costs us nothing more
May be useful to some member
Of our country's, country's score.

Because they may outstrip us in the race,
And leave us far behind, their steps to trace,
Is not the only reason why, nor less,
Than others we can name, or think, or guess,
That we our fellow worm should 'frain to snub,

E'en those that's closer in the certain hub
Of lowering guilt, of vile, or vilest crime,
That falling manhood, in our age and time,
May be susceptible of—because unjust,
Unchristian and unkind, and hence we must
Refrain from that from which there is no good,
And cherish better things, as well we should.
To render help in time of earnest need,
Should be our aim, our object and our creed,
To elevate the groaping, wayward soul,
That it may safely, shurely 'scape the goal,
The avenues to sin, to crime, to hell,
Which it may be induced to do as well.

There comes a man—I see his visage now—
He's not himself, as once, I do avow.
What makes him act so loathful and so rude?
With such a boisterous howl he does intrude
Upon the rights of others passing by
And common courtesy to them deny.
This personage was once his father's pride,
The care and solace of a noble bride,
A mother's comfort in her matured years,
And unremitting joy and comfort his;
But now what woeful changes there have been,
Since he from humble youth has grown a man—
The glowing spirit of the sparkling eyes,
The ruddy cheek that God to none denies;
The buoyant strength of an athletic frame,
Was once his noble heritage to claim,
But ah! alas! he's sacrificed all this,
The all substantial of the perfect bliss,
To crime, dishonor, and a wretched life;
Of woe, and misery—a drunkard's strife.
The causes which, have led him to this end,
Induced his humble spirit thus to bend,

And throw away the good and take the ill,
To satisfy the all-astounding will—
I will not stop to say, or to relate,
But leave him in his ill, his fated fate.
But why I'd ask, and would be pleased to know
For what you'd snub him for, thus being so ?
It certainly would give him no relief,
But add another fire to sad'ning grief.
Then, if a kindly word we would not give,
Then let him be, his sinful course to live ;
But do not add more burden to his lot,
But pass him by as one to be forgot ;
But rather in the best, the shurest way,
His reformation seek, without delay.
Thus lift him from the ditch, the sunken mire,
And do not let his energies expire
And waste away as though they ne'er had been,
The heir of earth, once joy, and not of sin.

These are not the reasons only
Why we should our time employ
To relieve the sick and lowly
From the place that so unholy
And so filled with woeful sin,
That no goodness can get in.
But for reasons stronger still,
That, that office we should fill—
That is, for his children's sake,
And his wife, whose heart did break,
When he left the goodly way,
Into paths of vice to stray ;
We would urge more stronger still,
That, that office we should fill.

Think of tears that she has shed,
And her love how it has bled,
And her life the groping flower,

That, that sin seeks to devour.
Think, her children must be fed,
And in proper paths be led ;
All are burdens to her care,
Assistance seek, and when, and where.
Think of these, and we'll be led
To hold up the drooping head
Of the needy and the poor,
For which Heaven will bless us more.

Some have a natural aptitude to snub
Those lower in the sphere or proffered tub,
Of contributions of the stores of earth
That came to them perhaps by simple birth,
And not a single effort of their own
Can give them preferred honors ; no, not one.
And yet, they seem to have the cherished thought
That they are worthy—rest to be forgot,
Or not to be allowed, permitted in
Their grand and social order, or their ring.
These are but haughty lordling's folly, pride,
Unworthy of a name, much less our guide,
To justice, honor, and to worth and right,
Which duty always warns us keep in sight
If we an honored, worthy name would leave—
A noble example to the world bequeath.
What ! think you that your heap of gold is king,
And all must succumb to that earthy thing
Which has inclosed you and its mighty power
Has webbed around you this day, this hour,
A mighty chain, which binds you to the earth,
Like Hydra, in its unrelenting girth,
And makes you thus and seemingly to think,
Though nearly at life's close and near the brink,
That earth might be your home forevermore,
And hence, the coveting of your earthly store ?

It's not from gold alone that we are led to snub,
But men of science, and of 'lustrous fame,
Of large, and high, of great and sounding name,
Have felt themselves superior in their might
Of lofty standing and superior height,
That they could hardly deign to notice those
That are not their equals in their ring or close;
And hence have passed them by with heedless thought
As though unworthy of—to be forgot.
Ah! foolish man! with all your boasted strength,
Of power of mind to work, to see, to think,
To open up, disclose and to divulge
The hidden secrets of this lower world,
(Than others, less perhaps in noble fame,
Have sought to make a high and sounding name)
Is but a little step that us doth grace
Our way, our course, and our terrestrial race,
And should not lead us thus to chide,
Our kindred worm, that's out, not in the tide;
But rather let us be inclined to impart
Our knowledge hence to each and every heart;
Use all our powers to elevate, to cheer,
Lift up our race and living mortals here
That life may be one great and noble charm,
Worth living for, for good and not to harm,
Nor cause a single heart to think or feel
But that our actions were for good and weal.
And hence, a blessing thus we will impart
To cheer and elevate the every heart,
And we'll rejoice in deeds of worthy fame,
Inherit more than a mere sounding name.

There is the fated poor in every land,
From causes not their own, nor from their hand,
Are hence predestined to be ever poor,
If born in city, town or on the moor—

It matters not, nor from what clime they hail—
The poor man's fate is theirs, though much they wail.
I will not stop to tell nor to relate
Why some are destined to this certain state;
Whether from laws of God or sin of man,
This charge is due, this fate, and if I can,
'Twould not the province of this chapter meet,
Nor make the story less, or more complete.
Suffice it thus to say the poorest poor,
In city, town, or on the distant moor,
Are not less good, nor human for this state,
Hence should demand our sympathy, not our hate.
But some there are in every land and clime,
And of the past have been e'en to the present time,
Who of a haughty lordling's unkind way,
Would snub the poor, and bid them ever stay—
E'en bind them down to servitude and chains,
To fill their coffers up, while thus they reign.

Of those, this tale would be much less complete
Should we disdain their crime to meet,
And to relate, though briefly as we may
The causes which have led them thus to stray
From honor, justice and the noble way
That all should strive to live the life-long day,
And cherish hard, and strive to nature's plan,
And do to others as we might, and can,
That would induce the world to better ways,
And throw around it belts of goodly stays,
That wrangling, warring and the strife of earth
May never find again its Hydra birth.
The causes which have led men to be vile,
To pinch the poor and many heart beguile,
Is love of gain—to fill their coffers o'er,
Of wealth, of gold, and seeking seek for more,
And thus aspiring for unworthy aim

They sell their souls and plunge into the main
Of worldly show, accumulate to gain
The paltry things of earth, but all the same
They labor on, and toil, to work in vain,
To get of that which must be lost again.
Ah! mortal man! this earth you heedless tread
And half forget the causes which have led,
Immortal powers to rear your being here
And give it power; e'en hope, and love and fear—
We hardly realize, though well we know,
Earth's treasures transient here to us below.

But yet we labor on and toil in strife,
Perhaps, to worry out a wretched life.
Of all the follies that beset us here,
So utterly repugnant to the conscience dear,
And that deserving condemnation more
Is snubbing of a one because he's poor.
Let each one bear these certain facts in mind—
And cease this folly, foolish snubbing kind—
That all are made of that one common clay
And must return to it no distant day.
In point of real worth of any kind
The cottage leaves the palace far behind—
The peasant may enjoy earth's comforts more
Than any lord, with all his wealth in store.
Then let us bear these precepts in our mind
And live to love and elevate mankind,
And God will bless and heaven's approving hand
Will lead us on at righteousness' command,
From this cold earth, when toiling life is o'er,
Unto that world of bliss, forevermore.

Let us from these lessons learn
Thus our duty to discern,
That our brother-man to meet,
And that him we duly treat,

That, that in this life of ours
We are led by unseen powers,
To assist, and comfort those
That require our 'sistance chose.

We have learned that life is real
And within our hearts we feel,
Should we live life's duty well
And escape the snares of hell,
We'll be earnest and for right,
Work for duty with our might,
Then our foot-prints in the sand
We will leave in honor's hands.

And should He subscribe our name
To the Book of noble fame,
Thus in doing we may feel
Life's for good, and that for weal,
And a heaven it will impart
To every good and righteous heart,
The thought, within ourselves to know,
The good seed we have sought to sow.

